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Forthcoming Events.

DECEMBER 11.

Institute of Metals (North-East Coast Local Section):—Ordinary meeting at Newcastle-on-Tyne. "Admiralty Gun-Metal," Paper by S. G. Homfray.

Institute of Metals (Birmingham Local Section):—Ordinary meeting at Birmingham. "Extrusion Problems," Paper by Major R. M. Sheppard.

Sheffield Association of Metallurgist and Metallurgical Chemists:—Ordinary meeting at Sheffield. "Some Modern Methods of Rapid Analysis," Paper by C. W. Ridge.

DECEMBER 13.

Institution of British Foundrymen (Birmingham Branch):—Ordinary meeting at Birmingham. "Brassfoundry Practice," Paper by F. W. Rowe.

Institute of Metals (London Local Section):—Joint meeting with the Institution of British Foundrymen. "Some Foundry Problems," Paper by A. H. Mundey.

DECEMBER 14.

Institute of Metals (Swansea Local Section):—Ordinary meeting at Swansea. "Some Applications of the Brinell Hardness Test," Paper by A. P. Norbury, M.Sc.

Staffordshire Iron and Steel Institute:—Ordinary meeting at Dudley. "The Diffusion of Phosphorous in Steel," Paper by Norman C. Marples, M.Sc.

Institute of British Foundrymen (Sheffield Branch):—Ordinary meeting at Sheffield. "Relative Values of Feeders or Denseners in Cast Iron, Malleable Iron, and Steel," Paper by E. Longden and H. Bradley.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institute of British Foundrymen.

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The Value of Co-ordination in Foundry Practice.

Apparently it is not generally appreciated by foundrymen that all foundries have but one thing in common, that is that molten metal is poured into moulds. Even sand is not necessarily a universal raw material. A natural rider is that no foundry is complete. There is primarily the natural division between the ferrous and non-ferrous, and these again are split up into numerous sub-sections. The former into heavy steel, light steel, heavy, medium and light grey iron, malleable iron, and speciality foundries, and the latter into heavy and light brass, die-casting and light alloy foundries.

Engineers, however, only appreciate the main divisions, and in placing orders primarily consider price, secondly delivery, and lastly quality. During slack times a buyer is often very satisfied because he has found some quite small foundry that can make the few castings necessary at a low figure. This foundry has probably very low overhead expenses, as the owner may fulfil a dozen duties, and his foreman and a handful of men complete the staff. The small foundry soon begins to be busy, and the finances of the concern are stretched to breaking point to keep pace with the business. In the meantime, the larger foundries are starved of the small amount of work which is going, and which automatically increases their selling price owing to the spreading over of the stationary overhead costs. Therefore there is a flow of work from the larger foundries to the smaller ones. The small foundry is not really making money, as all his income has to be expended in making additions to his works. When trade improves, the orders are too big for the little man and the work is transferred back to the larger foundries, whose overheads are reduced, moulding machines can be operated owing to the larger numbers required, and the small foundry begins to feel the competition.

Service, one of the most potent factors in modern business, suffers at least temporarily with the change of suppliers, and is to the detriment of the purchaser. Thus, neither the engineer nor the foundry gain as much as they should from the conditions which exist amongst foundries catering for the engineering industries, especially in the London area. Some system of co-ordination of effort should be effected in the very large number of foundries to which these remarks apply, otherwise the industry as a whole will continue to suffer as it undoubtedly does at present. The large foundries should co-operate with the small ones, and the class of work suitable for each type should be made in that foundry. The making of a 5-ton casting in a foundry with antique handling facilities necessitating the stoppage of all work for nearly an hour to load it on a lorry, is wrong, and sometimes dangerous. Again, the large foundries could put out work of a light character, instead of castings which overtax both the melting and handling capacity of the works. Co-operative buying has already been dealt with in this column, and is intimately associated with the present question. There is a great need for an association in many districts, especially London, which would have for its object the economic reception of orders, co-operative buying, and perhaps a co-operative pattern stores and laboratory. The first district which has the courage to form such an organisation will be in a position to "poach" seriously on other districts, as it would ensure work being done by the foundry best able to make it.

XUM

The Foundry and its Manager.*

By Leon Thomas.

During a recent conference of the "Association Technique de Fonderie," of France, the author of this Paper purposely emphasised the prevalence of rule-of-thumb methods which prevailed in a large number of foundries. As some members of his audience took exception to his remarks, the author explained that he had not said that *all* foundries were run on out-of-date methods. There could be no doubt, however, that the majority would benefit by modernising their plant, and especially their methods of working. A well known industrial magnate on his return from America had remarked how surprised he had been at the extent to which mechanical means had been applied to the work and the handling of material in the United States. He admitted that, in this respect at any rate, Europe was definitely inferior. Nevertheless, for twenty years past at least a dozen European foundries have been equipped with plant which can hardly be equalled in America. Quite recently a semi-continuous foundry has been erected, comprising transporters at four different levels, two complete working floors and casting effectively carried on at 15 ft. above ground level. The latest Ford foundry is the only one in America that can compare with this. In short, it may be said that if some of our foundries are rather antiquated there are others which can be compared with the finest in the world.

To speak of "the art of the founder" is no exaggeration, in spite of those who, after a visit to a foundry, can only recall a gloomy interior, the floor of which presents a succession of heaps and holes, a smoky, almost unbreathable, atmosphere in which workmen, barely clothed and nearly as black as the sand they use; the whole effect being, in fact, repulsive. In spite of all this, the work really does demand creative qualities.

The Old-Time Craftsmen.

The author recalled that at the beginning of his career he was working with a journeyman moulder in a foundry abroad. His "mate" had to make a large steam-engine cylinder weighing 22 tons. The design was extremely complicated, and the drawing to which they had to work was a complete general arrangement of the cylinder showing every detail in position. From this the moulder had to devise his own striking boards for the loam mould, set up the framework and construct the many intricate cores. Yet when the job was cast and the cylinder checked up in the machine shop it was found to be accurate in every respect; a result which, he averred, denoted true creative powers in the moulder. Although this incident occurred in a foreign foundry, he maintained that in the district of Haute Marne there were three families whose names would always be remembered in French metallurgical history—the Cordebarts, the Tissier family and the Drouots. These people, in spite of great opposition on the part of other powerful interests, accomplished some wonderful work. More than fifty years ago one of them had obtained a sub-contract for some highly decorated columns, nearly 35 ft. high. These were made at the rate of one per day, the mould and cores being in green sand. The man who undertook this work exhibited great powers of decision, high skill and great energy; he had, in fact, all the essential qualities of a "chief." To-day the times are changed; these workmen—rather given to wandering—are extremely rare, and those that remain only remotely resemble their ancestors. Fortunately (or unfortunately) moulders are now more settled; they remain in one factory, or at any rate, in one district. The result of this is that the owner of a foundry can only take on an important order if he has the men with the necessary skill to carry it out, or can himself say what method of manufacture should be adopted. That is exactly where the foundry manager should come in, and it will be well to say a few words about his duties and his responsibilities.

Cutting out the obvious qualifications which everyone can enumerate, he would try to outline step by step what constitutes the ideal foundry manager. On the receipt of an inquiry from a prospective customer the details are at once submitted to the foundry executive service. The foundry manager must proceed to calculate the weights of the castings if they are not stated, make sure that he has all the facilities for carrying out the work; that is, sufficient room, crane power, store space, ladle capacity, etc. Having satisfied himself on these points, he must make a study of the job to decide on the method of moulding and the disposition of cores, etc., always keeping the factors of safety and economy in mind. For this he must have a clear conception of the skill of his men and the limits of his plant.

Broadly, he must decide on the boxes, core boxes, etc., and estimate their cost and that of any alterations which may be necessary. In consultation with the pattern maker he will give an estimate for the patterns or any special gear that may be required. If, in his opinion, this price seems too high, he must study the problem afresh with the idea of cutting down the pattern costs, even when this means an increase in his own section of the work. An estimate of the time to complete the job must be made, and the price of the various items, moulding, core making and even dressing, must be fixed. His knowledge of the profession must be profound enough to appreciate as a whole the figures he has arrived at by stages, either with the help of tables or by itemising the work. He must not hesitate to consult his foremen and charge hands, submitting to them his ideas of carrying out the work and so engaging the immediate interest and responsibility of those who will carry out his instructions. If he thinks the job will require special mixtures of core sands, he must fix the composition and price of them. The grade of iron and the dimensions of gates and risers must also be determined by him. When fixing delivery dates, he must take into account not only the time required for making the patterns, moulding, dressing, etc., but also that necessary for drying and cooling off—with an allowance for unforeseen delays.

Importance of Visualising Work.

Having communicated his results to the commercial manager and assuming that the order is subsequently placed, the foundry manager again comes in. A complete study of every phase of the job—if very important—must be undertaken. The form and position of the sections, the disposal of vents, the time for filling the mould, the resulting pressure, means for equalising this pressure, dimensions, form and weight of frames and body, manufacture and venting of cores, process of drying, assemblage of mould, position of chaplets and their dimensions, precautions taken for the rapid and free dispersal of the gases, provisions made for shrinkage, etc. The exact requirements for patterns or striking boards must be given to the pattern-shop, accompanied by sketches where necessary. The previous estimates of times for moulding, core-making, etc., must be checked and the resultant prices verified.

When the patterns are delivered to the foundry, they *must* be carefully checked in every particular, not only dimensions, but the arrangement of the respective parts must conform exactly to the instructions that were laid down. If the pattern is passed into the moulding shop without being checked, the foundry manager becomes responsible for any errors that may crop up later.

The next steps will be to locate the situation of the mould, and determine the amount of excavation which will be fixed by the strength of the sand. Having assembled the necessary boxes, he will then instruct the charge hands, moulders and core-makers, stating clearly and concisely how he proposes the different operations be carried

* Translated from a Paper presented to the Paris Foundry Congress.

out. He issues the requisition forms giving dates and prices and details of moulds, cores, venting, etc. At this time he will consider any criticisms, but should refuse to listen to any objections raised later. A job put through under these conditions has a 95 per cent. chance of getting through successfully, which certainly cannot be said of work carried out on the old policy of muddle-through, which, alas, still holds in so many foundries. During the actual making of the casting, the manager's job is simple enough, since, if all has been foreseen, he confines himself to seeing that his instructions are faithfully carried out. Later, however, he must personally supervise the drying of the mould and the final dimensions; the assemblage must be followed from end to end, and the arrangements for casting. In connection with the latter operation, his is the responsibility for superintending the starting-up and operation of the cupolas, the temperature and appearance (if not the composition) of the metal, the lining and tilting gear of the ladles, and he must assure himself that the cranes and all handling gear are in order. All foundrymen who have taken part in the actual casting of an important casting will appreciate that the most hardened manager feels some anxiety during the seconds which elapse between his order to teem the first ladleful and the filling of the mould.

For that reason, and also for strong technical reasons, the writer has always endeavoured to make the actual casting time as short as possible. But imagine the satisfaction of a chief worthy of the name when he sees the successful completion of such a casting and realises that he has been able to foresee every detail.

Qualification Defined.

From what has been said, it is now possible to define, broadly, the qualifications necessary for a foundry manager. They may be enumerated as: Experience derived from observation and from notes made in the various shops in which he has worked; a clear understanding of, and some ability to make, mechanical drawings; a knowledge of geometry enabling him to calculate areas, volumes and weights; the strength of materials, calculations on tie bars, framework, cables, beams and crane hooks. He should have a working knowledge of physics, expansion and contraction of metals, compressed air, hydraulics and electricity. Chemical knowledge should embrace the analysis of irons, coke, sand, slags, limestone and gases. For mechanical construction, moulding machines, pattern plates, combination of parts and mechanical movements. In financial matters he should be able to arrive at net costs of productive and supplementary labour, general expenses and ability to maintain costs at the determined figure. Finally, the ability to control men, with firmness and a profound sense of honesty and justice. But these requirements are precisely those for an engineer, which is why, we note with regret, so few technical students choose the foundry for a career; they prefer the beaten tracks of mechanical or electrical engineering. This is especially to be regretted when they are not gifted with the mechanical sense and craftsmanship; such may make a fair mechanic, but he will not originate anything, whilst, if he is observant, has tenacity of purpose, or even a simple recorder, he will become an excellent metallurgist, a first-class foundry manager. It has been well said that "a mechanic is born, a metallurgist is made."

From all that has been said above of the knowledge required and the responsibility entailed by a foundry manager, it is evident that his remuneration should be commensurate and that his position should be assured so that he may devote to his profession the close attention and concentration that it demands. In speaking of the moral situation, it should be noted that there are foundry managers who make no attempt to improve their position, but follow too closely the methods of their forefathers, whose chief concern seemed to be getting the metal into the mould!

The author knows of a foundry manager, a most competent man, who, before making an important casting, donned a clean shirt and collar; theatrical perhaps, but it showed in a striking manner his appreciation of the importance of the operation he was about to direct; there is no doubt that his example favourably impressed the other men taking part in the work.

It should be the work of every member to endeavour to raise the foundryman's art to the rank it should long ago have occupied; truly to appreciate the difficulties encountered every day, to struggle to improve the social standing of foundry workers, especially the managers, who must all combine to be present at technical conferences and take part in all discussions. It must be remembered that the engineering industry will not be able to exploit the mineral wealth to the best advantage unless everything is done to encourage the intermediate industries of which ours is the chief. There must be no more water-tight compartments in the industry, but, on the contrary, a close co-operation.

A Foundry "Custom of Trade" Decision Given.

In the King's Bench Division last Tuesday, an action was heard before Mr. Justice Roche in which the plaintiffs, the Derwent Foundry Company (1920), Limited, of Exeter Place, Derby, claimed to recover damages against Lake & Elliott, Limited, iron and steel founders, etc., of Albion Works, Braintree, Essex, in respect of an alleged breach by the defendants of a contract entered into in the month of December, 1920, for the purchase by the defendants from the plaintiffs of 3,000 sets of door check castings and 130 hexagonal bars. Mr. Winning appeared for the plaintiffs, and Mr. Van den Berg for the defendants. Mr. Winning, in opening the case, said that the claim was for damages for an alleged breach of contract by the defendants, and alternatively there was a claim for loss of profit, and a sum of about £117 that it was said the defendants had offered to pay in settlement. The defence was that the defendants were justified in cancelling as they did, because of the plaintiff's delay in delivering, and that there had been a waiver by the plaintiffs of the claim, and reliance was also being placed on an alleged custom in the trade. The custom was to the effect that if patterns were made for one customer and used for another the customer for whom they were first made was not liable. The goods in question were never delivered, the defendants claiming that there was undue delay, and that they were entitled to cancel, and it was also being said by the defendants that there was an arrangement by which another firm came in to take the castings in such a way that the defendants were relieved under the contract. The plaintiffs disputed that this was the case.

For the plaintiff's case, Mr. J. E. V. Jobson gave evidence that the value of the order was about £595, and the profit that would have been earned was £100. He did not agree that there was any arrangement by which if another firm took the goods the defendants would be released.

For the defendant's case, Mr. Eley, of the firm of Badger, Cookson & Company, said that they took castings from the plaintiffs, the idea being to help the defendants, and when they learned that the plaintiffs were proceeding with their claim they declined to take any more.

Mr. W. B. Lake, of the defendant firm, deposed that his firm had a contract with Nettlefolds for the completed article, but Nettlefolds cancelled because of the delay in delivery. Witness then sought to cancel with the plaintiffs.

After other evidence his Lordship said he was of opinion that the custom pleaded was not established to make a defence to the claim. He thought that under the circumstances the defendants declined to accept deliveries before a reasonable time had elapsed, and that although some kind of arrangement was come to with another firm the plaintiffs did not waive their rights under the contract. He found that the plaintiffs were entitled to recover their loss of profit, and he gave them judgment for £100 and costs.

Austrian Alpine Montan Company.—Herr Stinnes is to resign his position as President of this concern. His shares are to be acquired by a financial group under the leadership of the Escompte Company, of Lower Austria. The new President is to be Castiglioni.

Wolfram and Tin in Tonking.—The French Mining Company reports that during 1922 it was not possible to resume work at the wolfram mine. The equipment at the tin mine was considerably improved, enabling the company to increase the output of tin by more than 40 per cent., compared with 1921.

XUM

Practical Points on Testing Annealing Stoves.

By "CELSIAN."

The advantages gained by employing draft-gauges at annealing stoves is scarcely fully appreciated by many engaged at the heat-treatment of metals in this country.

The chief use of the draft-gauge is to enable the fireman to regulate the temperature of the stove to secure the best results.

It is well known that raising the damper at the base of the chimney will usually increase the draft in the stove, but the exact amount of increase can only be obtained by means of the draft-gauge. The customary method of marking the damper is of little account, although better than no indication whatever, since the increase rests partly on the temperature of the waste gases and partly on the atmospheric conditions.

By employing a draft-gauge and a pyrometer, the effect of adding more fuel and varying the air supply can be accurately found. Attempts to ascertain facts without the aid of these instruments is little short of guesswork. Where rolls or other heavy castings are to be annealed, such guesswork might lead to serious results, since the soaking of the heat might not be maintained uniformly. Smaller castings, although not likely to be badly affected, should always be annealed, under scientific conditions where satisfactory results are desired.

The value of such devices has been proved in many works when a metal of definite structure is wanted. Their installation is comparatively cheap when it is remembered the amount of fuel they save. A good fireman should know how to regulate the fires so as to burn coal in the best possible manner and ensure the proper supply of air to the fuel.

Besides effecting complete combustion of the coal gases, it is necessary to distribute them so that heat is uniformly produced throughout the stove. Regulation of the fires to secure a desired result can only be learnt by experience, and little practical information can be gained from text-books. A matter of equal importance is the correct distribution of the volume of hot gases among the castings. This can only be accomplished by means of accurate placing or setting of the castings on the floor, so that channels of similar dimensions are formed for the gases to pass along. The addition of the proper supply of air and the removal of the waste gases require constant attention. Where special steels are to be annealed, it is a usual practice to provide a means of recording whether these matters are given the necessary constant attention. This is done with the aid of two pyrometers and two draft-gauges, both of the recording type.

One pyrometer and one draft-gauge are fitted at the base of the chimney, or in the main flue in the near vicinity of the chimney base. These show whether the chimney is working correctly, that is, drawing a sufficient draft or not, and whether the gases flowing to the stack are too hot and therefore causing an unnecessary waste of fuel.

The record of the draft at the base of the chimney shows whether irregularities in the annealing chambers are due to the mode of firing or to the wind, or other atmospheric conditions. When the chimney draft is steady, an uneven draft in the stove itself is an indication of unskilled firing. The second draft-gauge is connected to one of the holes in the wall of the stove, situated at a considerable distance from the fire and towards the direction in which the hot gas is flowing.

The second pyrometer is inserted in a part of the chamber where it can record the temperature produced in the bulk of the stove, and where the flame cannot play on it directly.

When serious differences are observed in the readings of the two draft-gauges, the reason can soon be traced. A constant temperature should be shown by the pyrometer at the stack, and can only be varied by bad management of the stove.

The record of the temperature in the hot annealing chamber, when firing up at first, should show a steady rise until the necessary degree has been attained. The draft-gauge connected to the stove shows not only the changes in draft, but indicates each time the firing has been conducted, and thus serves as a record of the work done by the fireman.

Consistent firing within a fixed period can be easily maintained, and any variations as shown by the draft-gauges indicate either bad management or abnormal atmospheric conditions. Correct management of annealing stoves cannot, of course, be ensured by simply installing the instruments mentioned, but errors can be observed before much harm is done and corrected without loss of time. A capable annealer making proper use of these instruments can also show an employer exactly wherein the stove is defective.

As annealing stoves are usually worked on both night and day shifts, these recording instruments can soon indicate whether one of the firemen is less skilled than the other.

It has been stated that the temperature should not exceed 150 deg. C., but in actual works practice a much higher figure is usually reached. In some districts it was found necessary to allow the gases to pass away at more than double this figure, in order to create a sufficiently powerful draft, partly owing to atmospheric conditions.

This is a costly matter, and in many ways it would be much cheaper to employ a fan instead of a chimney. Increasing the dimensions of an annealing stove is a matter which can only be satisfactorily considered if the services of these recording instruments can be secured. As is readily evident, it would pay to lengthen an annealing stove so as to anneal more castings with the same amount of fuel.

Industrial Welfare Society.

The Fifth Annual General Meeting of the Industrial Welfare Society was held at the Society's offices, 51, Palace Street, Westminster, London, S.W.1, on November 21. Owing to the proximity of the General Election, the proceedings were purely formal. H.R.H. the Duke of York, President of the Society, said that the desire to give fuller recognition to human values in industry had for many years produced its worthy exponents, and they gave ungrudging honour to those pioneer students of the new science of what had been termed "Industrial Humanics." The Society owed its existence to the need for some organisation to give fresh impetus to the ideas underlying the welfare movement to enlarge the old conception of the duty of the employer towards his workers, as well as the responsibilities of the workers towards their employer, to rekindle sympathies which might have been forgotten in the race for material prosperity, to show how difficulties could be removed and better understanding created. They were confident that in the mining centres, the shipyards, the factories and mills where welfare schemes had been introduced, nothing but good had resulted. "In such places," continued the Duke, "very real human relations are being built up, and a spirit of mutual understanding is being created, and I am not sure that in the end we shall not find that simple human feelings will solve many of the problems which have baffled our industrial leaders for many a long year. The Duke concluded by thanking the members of the Council and staff, mentioning Mr. S. E. Alley (Chairman of the Sentinel Wagon Works, 1920, Limited), the hon. treasurer, "to whose constant endeavour and single-minded tenacity the Society owes its position to-day."

Lord Invernairn (Messrs. William Beardmore & Company, Limited) moved the adoption of the fifth annual report, and this concluded the proceedings.

THE POWER GAS ECONOMY COMPANY, 50, Wellington Street, Glasgow, have received nine orders for Hunter gas burners during October, covering in all 46 burners. These included orders from the Ebbw Vale Steel, Iron & Coal Company, Limited, Pease & Partners, Limited, the Consett Iron Company, Limited, John Lysaght, Limited, two from France and one from Spain. The company have a new automatic gas burner for Cowper stoves, one of which has just been delivered to the Moss Bay Works, and one to J. Hickman, Limited.

The Foundry of Messrs. Morris Motors, Limited, with Special Reference to Continuous Core Drying.

Probably the foundry of Messrs. Morris Motors, Limited, of Oxford, is the most highly-developed speciality foundry in Great Britain. It specialises exclusively in automobile castings, and its capacity can be best gauged by realising that it is turning out 500 motor cylinders every week. The works are situated at Cowley, about three miles from Oxford, in a rural situation.

A general idea of the foundry, which made its first cast on November 24, 1919, will be gained from a study of the line drawing (Fig. 1) and the illustration (Fig. 2). It should be clearly understood that Mr. A. Smith, the foundry manager, who has been mainly responsible for the design, does not consider it to be ideal, but growth has been so rapid that extensions have had and are still being made to cope with the demand for the well-known Morris Oxford and Morris Cowley motor-cars. This continued growth has largely complicated the original scheme, and Mr. Smith has adopted the rather novel course of installing in his office a large drawing board showing in black lines the walls, columns and other definite "unmovable" items. For each item of plant he has had *jetons* prepared to scale, and these are tacked into various positions and are studied in the light of transport, piping, and other considerations. This process is now being enacted as a sand slinger is to be installed.

Transport Arrangements.

Specialising in road transport, the absence of railway facilities did not weigh heavily against choosing the present site. From the foundry manager's point of view this has its advantages, in as much as consignments of pig-iron can be more conveniently dumped over a larger area, whereas with railway sidings urgency usually demands stacking near to the lines, and the arrival of a large consignment often restricts this area and involves a second handling. Mr. Smith has installed in his stockyard a series of poles resembling tramway standards, and on the arm are hung the tallies, which are legible but just out of reach. This system has superseded the method of resting small tally boards on the various stacks, which a labourer removes and places on a neighbouring stack when it is in his way, and possibly replaces it on completion of his work by the wrong tally.

The foundry, which is 240 ft long × 120 ft. wide, divided into two main bays, is spanned by three 2-ton Heywood (Reddish) overhead travelling cranes. Obviously these would be totally incapable of tackling the transport for such a foundry, and a very extensive system of 2-ton steel bogey trucks has been installed. These trucks are by Messrs. Robert Hudson, Limited, but the roller bearings have been modified by the maintenance staff so as to reduce to a minimum the wear always associated with foundry sand. It is evident that the question of sand in working parts has had a considerable amount of thought expended upon it, for it is again encountered in Mr. Smith's design of turntable for the trucks. As will be seen from Fig. 3, the sand is prevented from entering the working parts by an oil seal, detailed at the right-hand side of the drawing.

The Foundry Proper.

All departments are housed under the same roof. The paths are concreted, of good width, and are kept clear of all obstructions. Between the two bays and near to the Lucas continuous drying stove an expanded-wire core-store is installed. Every core, after inspection, has to be booked in, and unless a core is the sole production of a single employee, it possesses a mark identifying it to some individual who, being on piece work, receives a credit for it on entering the stores.

Pattern Shop.

This shop, shown in Fig. 4, is 88 ft. long by 16 ft. wide, and is equipped with a Sagar combined thicknessing machine, supplemented by the usual tools. The pattern store is carried on an elevated platform in the foundry itself. It is, however, well removed from danger due to liquid metal splashes. The patterns are reinforced with iron and steel plates, and are stated to make as many as 11,000 castings.

Core Sand Mixing.

Cores are made from either a mixture of Leighton Buzzard No. 3 and sea sand or entirely of Leighton Buzzard No. 6. A rotary drier conveniently fixed through an outside wall allows the damp sand to be fed in from the large sand bins and to deliver dried sand near the sand-mixing plant. This includes two E. T. Neal (Kettering) sand mills. These have 6-ft. pans and are under driven. The mixture used to make oil-sand cores is 2 cub. ft. of sand with 1½ pints of linseed oil, 1½ pints of treacle, and 1 lb. of Dextrine.

Facing Sand.

Just near to the foundry is a sand deposit, which is utilised in the foundry. It contains 86 to 90 per cent. silica, 2.4 to 4.8 per cent. iron oxide, 6 to 8 per cent. alumina, and 0.9 to 2.5 per cent. of magnesia and lime. The mixture used for facing sand is 75 per cent. old sand, 12.5 per cent. of Stourport, and 12.5 per cent. of this local sand. Practically all the moulds are dried. The position of the sand mills is shown on Fig. 1. These mills are overhead driven.

Melting Plant.

The melting plant consists of two 4-ft. shell cupolas by Evans and the Constructional Engineering Company. Two additional cupolas are on order from Messrs. Evans, which melt 3 to 4 tons per hour. They are provided with a roomy platform served by two 10-cwt. electrically-operated hoists by Wadsworth, of Bolton. No semi-steel mixtures are used, but the burdens are so regulated that a total carbon content of 3.2 per cent. is maintained.

Blower and Compressor House.

The cupola blast is provided by a Hodges turbine blower capable of delivering 2,300 cub. ft. per min., and driven by a 15-h.p. motor. Compressed air is furnished by three Sentinel compressors, two delivering air at 85 lbs. per sq. in., and one, for the sand blast, at 35 lbs. per sq. in.

Moulding Equipment.

For moulding, ten No. 1 and three No. 0 Britannia machines are installed, to which the management has added its own design of vibrator. Additionally, there are four Grimes' hand-rammed, roll-over machines, and one Grimes' jar-ram machine. In the core shop there are installed twelve roll-over pattern-drawing Grimes' machines.

Mould Drying.

From Fig. 1 will be seen the disposition of the mould drying stoves. These have been designed by the management and are gas-fired. They are five all told, and the average size is 12 ft. 6 in. × 16 ft. The average time for baking motor casting moulds is 6½ hours, at 350 deg. F. The moulds usually remain in the stove until morning.

Core Drying.

Undoubtedly the outstanding feature of the Morris foundry is the Lucas continuous core-drying plant. There are two in operation, as will be seen from Fig. 1, and are placed at right-angles to each other. The larger one is definitely for drying, whilst the smaller one is redrying after blacking. The ovens (Fig. 5) have been designed by Mr. E. Lucas, of Messrs. Lucas Furnaces, Berkeley Street, off Broad Street, Birmingham, and the gearing and conveyor grate by Mr. A. Smith, the foundry manager. The larger stove is 40 ft. long × 4 ft. wide. It is town's-gas fired, and the sections of the burners are independently controlled, and designed to give a uniform distri-

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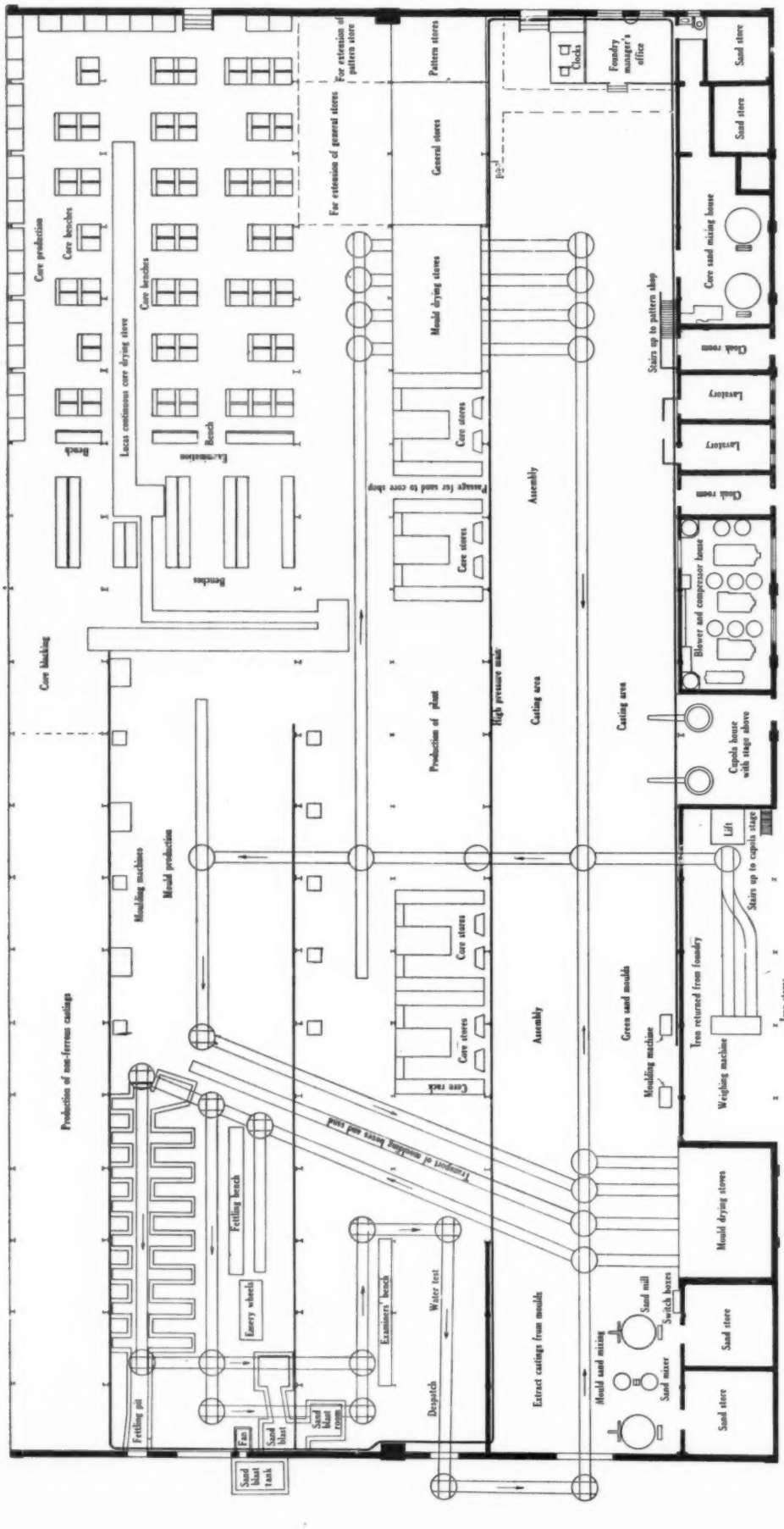

FIG. 1.—THE GENERAL LAYOUT OF THE IRON FOUNDRY OF MESSRS. MORRIS MOTORS, LIMITED, OXFORD.

bution of heated air. The heat losses are much smaller than our representative would have expected. Throughout the whole length of the roof a number of Cambridge-Paul thermometers are fixed, enabling the central-zone temperature to be maintained at 450 deg. F. The speed of travel is but 18 ft. per hour, and the two stoves, the smaller of which is 20 ft. long × 4 ft. wide, are driven by a 2-h.p. Crompton motor. The speed of movement of the conveyor belt's running through the furnace can be varied from 12 to 24 ft. per hour. It is provided with a reduction gear of 10,000 to 1, placed in between the motor and conveyor driving shaft. This conveyor is 4 ft. wide, but for future installations it is proposed to reduce this to 3 ft., in order that unloading may be conducted from one side of the belt without undue stretching. Messrs. Lucas Furnaces are supplying a further installation on these lines. Though this plant has been in continuous use for eighteen months, the design of belt is such that no sign of wear from sand abrasion is evident. Whilst this is a type of plant which one usually associates with American foundry practice, our representative was convinced that, where output warrants, continuous core drying is a commercial proposition for British foundries.

FIG. 2.—GENERAL VIEW OF FOUNDRY OF MESSRS. MORRIS MOTORS, LIMITED, OXFORD.

The town's gas drying of cores is considered by most British foundrymen to be both economical and desirable where its price is at all reasonable. Once installed labour is eliminated so far as transport of fuel and ashes is concerned. Now with a continuous process one could anticipate losses owing to the ends of the furnace being open. However, by a well-considered system of flues these losses can be minimised and the efficiency can be equal or superior to ordinary gas-fired furnaces, as the following figures kindly supplied by Mr. Smith will show. It should be borne in mind, however, that the continuous furnace has a larger capacity.

Gas-Fired Oven Stove.

Weight of cores before drying, 21 cwts. 3 qrs. 14 lbs.

Gas consumed during drying period, 7,010 cub. ft.

Labour, 2 men for 9 hours each.

Cost of Cores per cwt.

Gas, 320.4 cub. ft.

Labour, 11.93 pence.

Lucas Conveyor Stove.

Weight of cores before drying, 70 cwts. 2 qrs. 15 lbs.

Gas consumed during drying period, 15,794 cub. ft.

Labour, 4 men for 8 hours each.

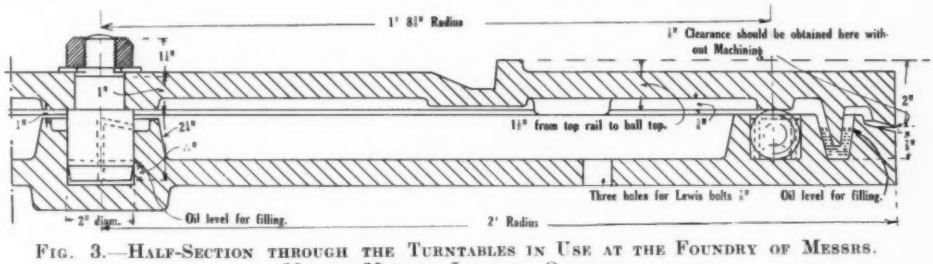
1' 8½" Radius
1" Clearance should be obtained here without Machining
1½" from top rail to ball top.
Three holes for Lewis bolts
Oil level for filling.
2' Radius
Oil level for filling.

FIG. 3.—HALF-SECTION THROUGH THE TURNTABLES IN USE AT THE FOUNDRY OF MESSRS. MORRIS MOTORS, LIMITED, OXFORD.

Cost of Cores per cwt.

Gas, 223.7 cub. ft.

Labour, 6.57 pence.

The weight of cores mentioned for oven-drying

Fig. 4.—The Pattern Shop. Messrs. Morris Motors, Limited, Oxford.

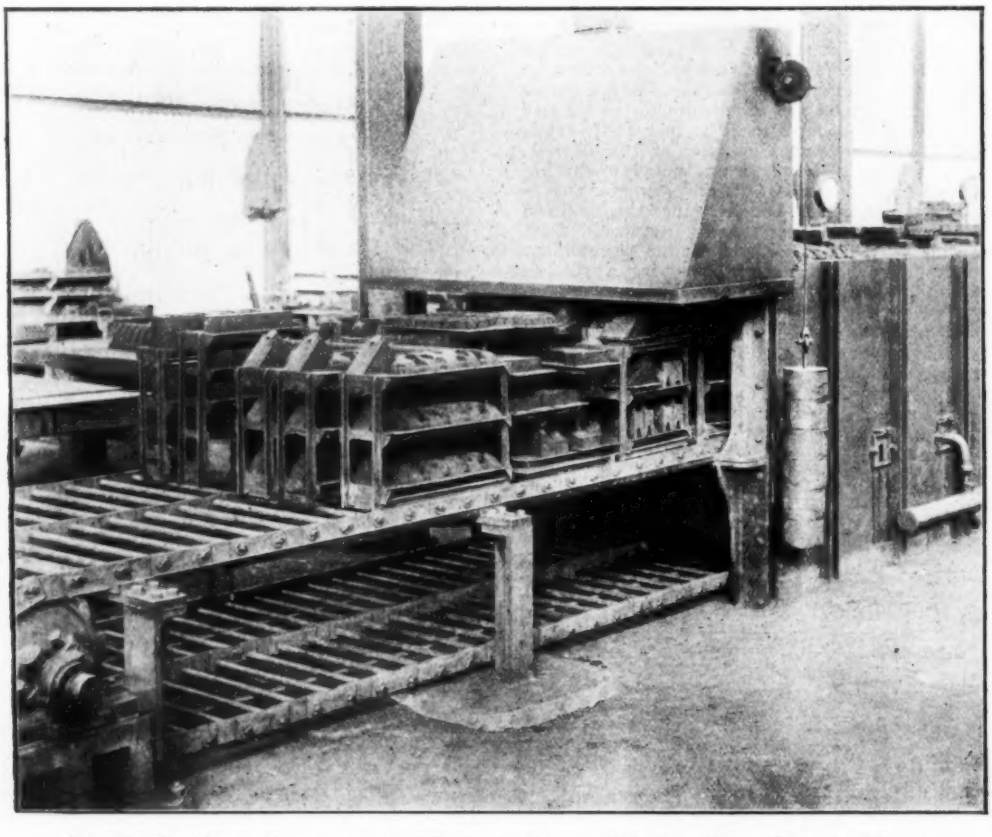

Fig. 5.—The Lucas Continuous Core-Drying Stove. The Exit End. Messrs. Morris Motors, Limited, Oxford.

Fig. 6.—The Assembling and Casting Bay. Messrs. Morris Motors, Limited, Oxford.

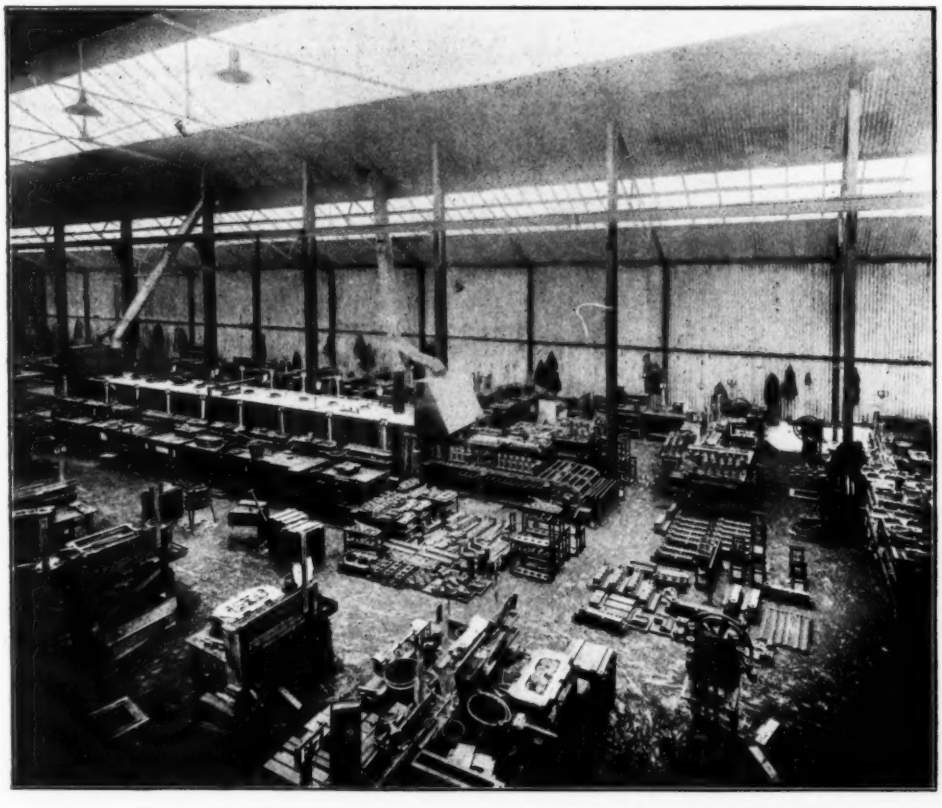

Fig. 7.—Part of the Core-making Section and General View of the Conveyor Stove. Messrs. Morris Motors, Limited, Oxford.

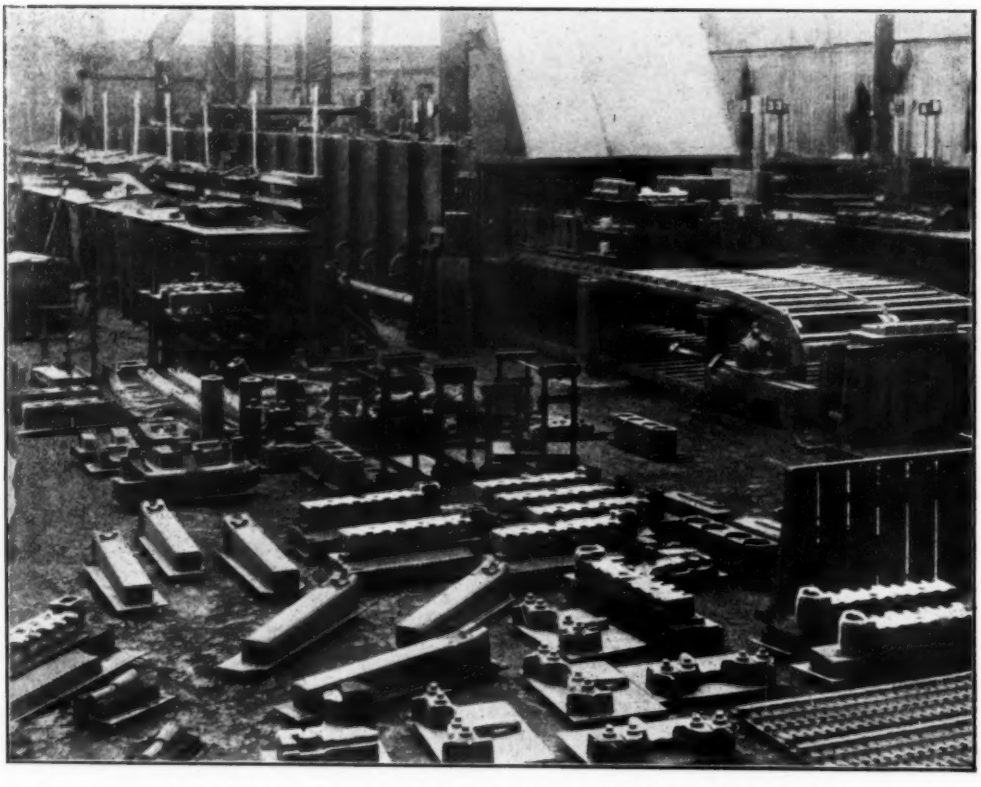

FIG. 8.—THE CHARGING END OF THE LUCAS CONTINUOUS CORE STOVE.
MESSRS. MORRIS MOTORS, LIMITED, OXFORD.

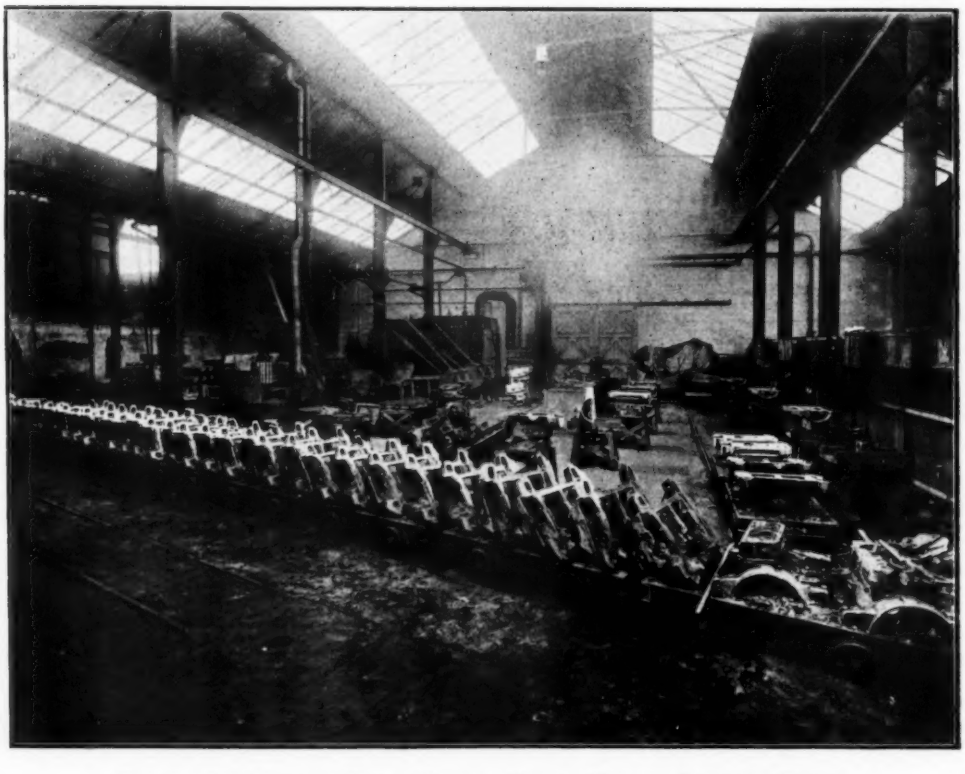

FIG. 9.—THE FETTLING BAY. MESSRS. MORRIS MOTORS, LIMITED, OXFORD.

stove was one complete load; in the ordinary routine they should get two loads per day. The company could not, of course, take less than a complete day's run on the conveyor stove, but owing to the convenience and economy of the latter they

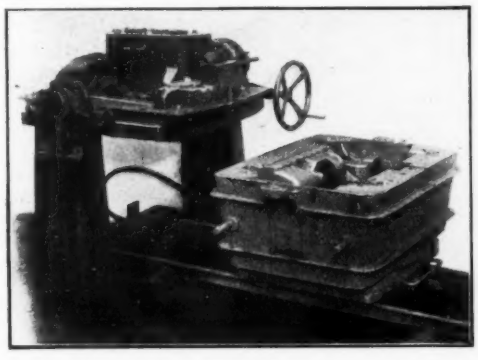

FIG. 10.—SHOWS THE MOULDING MACHINE, PATTERN AND MOULD FOR A MORRIS CYLINDER.

have now cut out the oven-drying stove by running the conveyor for a little longer period, which still further reduces cost.

Mr. Smith points out that in arriving at the above results of the test on the conveyor stove,

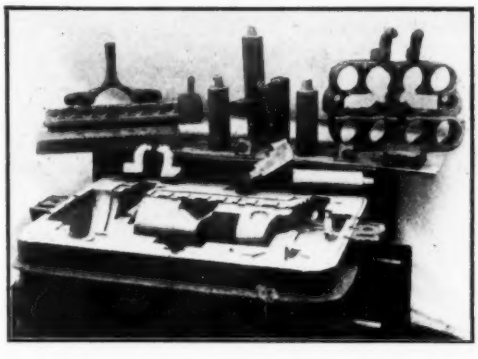

FIG. 11.—MOULD AND CORES READY FOR ASSEMBLING.

he has allowed for 29 per cent. of the total gas used for the consumption of the blacking drying stove, whereas calculating on the basis of the respective burners in use, this stove actually consumed 29.9 per cent. The above weight represents

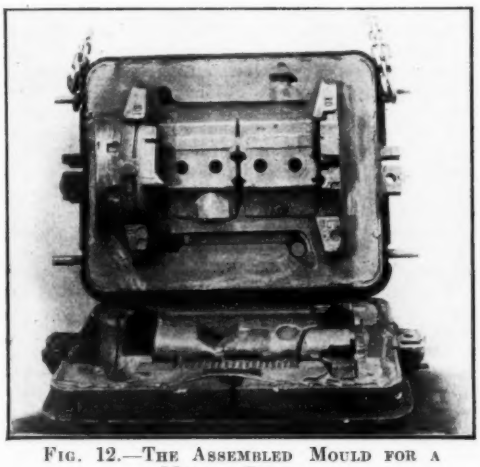

FIG. 12.—THE ASSEMBLED MOULD FOR A MORRIS CASTING.

72 complete sets of cores for the Morris 4-cylinder block. The time occupied in stoving was 10 hours, the loading and unloading times were both 7½ hours for two men. In the new installation the labour and fuel costs are expected to be reduced.

Fettling Department.

This department is situated at the despatch end of the foundry buildings. There are two Tilghman sand-blast cabinets and two Luke and Spencer grinders, the one carrying 20 in. × 4 in. and the other 18 in. × 2 in. wheels. There are numerous fettling trestles with turntable tops—an excellent system, also used in the moulding shops—which saves much exertion in turning round castings or moulds. Beneath each trestle is a grate for dealing with the dust.

Other Features.

Though a quantity production shop, with extensions always in progress, a striving after high quality and other factors constantly operating, its outstanding feature is the attention which is bestowed on detail. The compressed-aircocks have been designed in the foundry, and are pressure-controlled to the exclusion of actual taps; wheelbarrows have been redesigned to eliminate "drunken" wheels; and moulding boxes have been altered so that they never leave the foundry for machining. Briefly, the system employed is to produce the moulding boxes with chilled faces of accurate depth, the latter being controlled by distance bushes between drag and cope. The pinholes in the lugs are cast larger than required after fettling, the box is placed in a jig, and expanding pins are run through jig and box, and brass or gun-metal bushes are run in.

This system is covered by Mr. Smith's patent No. 131,263 taken out in conjunction with Mr. J. Gasgoine. It ensures accuracy within fine limits, and enables the foundry to maintain its independence of the machine shop without the delay

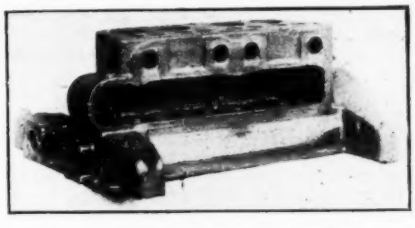

FIG. 13.—THE FINISHED CASTING.

usually associated with machine catering for foundry requirements. Under this system the Morris concern are in the habit of casting moulding boxes one day and producing moulds in them the next day. The success of this system is obvious, when it is considered that the whole of the moulding boxes in use are made according to it.

The laboratory has been installed which analyses the whole of the raw material received into the works, the routine work including pig-iron, coke and sand.

Figs. 10 to 13 illustrate the making of a Morris 4-cylinder motor block. Fig. 10 shows the pattern, Fig. 11 the moulding of the mould and a complete set of cores, Fig. 12 the mould with the cores assembled, and Fig. 13 the finished casting.

Personal.

SIR HUGH BELL has been re-elected chairman of the Tees Commissioners.

MR. E. B. WOOD has been awarded the Crompton Medal of the Institution of Automobile Engineers for his paper on "Sleeve Valve Engines."

SIR ALLAN SMITH, chairman of the Industrial Group, has resigned on the question of the Government's policy, and has been succeeded by Sir Edward Manville.

MR. J. C. LLOYD and Mr. W. Waddell have been appointed joint chief engineers of the Great Western Railway Company, in succession to Mr. W. W. Grierson, who will retire at the end of the year.

MR. J. BLUNT has been elected chairman of W. Tyzack, Sons & Turner, Limited, Sheffield, in succession to the late Mr. F. Tyzack. Mr. W. Tyzack retains the managing directorship.

An Apprenticeship Course in Foundry Practice.—LXVI.

By Ben Shaw and James Edgar.

BRASS FOUNDRY FURNACES.

There are so many questions involved in the consideration of the most suitable furnaces for brass foundry use that it is difficult to adhere to a uniform comparison of different types. It is not only the working of the different types that varies, but the source of heat, and in order to estimate the value of any particular type these factors must necessarily receive special consideration. The class of work done and the ready supply of suitable fuel at low relative cost must also be kept in view. The economic working of a furnace is a very important factor, and one which is frequently overlooked. Furnaces are often dumped into a foundry without any apparent consideration being given to their successful working. Melting practice in non-ferrous foundries has been receiving considerable attention during recent years, and much research work has resulted in a wider variety of furnaces, which, under certain conditions, give excellent results, but unless makers take the trouble to ensure that they are worked under the most suitable conditions, they inevitably become recognised as costly experiments. This possibility can, of course, be considerably reduced if the foreman at least makes himself acquainted with the various types of furnaces that may be used in the brass foundry, but since much time will have been expended in perfecting a furnace, the makers should give proper advice for both installing and working, in order that the best results are likely to result. Apprentices should make themselves acquainted with the different type of furnaces by observation and comparison when that is possible, but since the facilities presented to them are usually limited to one or two furnaces, a general consideration of the different types, together with such comparison, will no doubt be advantageous.

It is questionable whether there will ever be a furnace designed that will conform to requirements under any circumstances and meet with the approval of users. The majority of foundrymen possess very definite opinions as to which they consider the best type of furnace, but since their conclusions are confined to those that have come within their practical experience they are likely to be influenced by one type from a very limited selection.

There is considerable variation in the types as well as in the method of obtaining the heat. Thus, for instance, there are pit furnaces, reverberatory furnaces, tilting furnaces, roller furnaces, lift-out furnaces, etc., not all of which are necessarily crucible furnaces, although crucibles are involved in the majority of furnaces used. The fuel employed may be coke, coal, gas or oil, whilst electricity is being increasingly used for the purpose. It is not possible to deal comprehensively with this question of non-ferrous furnaces within the narrow limits of an article of this character, nor will it be possible to consider all the types that are in use, but a general comparison of the more common types, as far as it is possible to make a comparison, will, we hope, inspire apprentices and young journeymen to take a greater interest in the melting facilities that are within their range of observation and help them to have a better understanding of their relative merits.

Coke-Fired Furnaces.

Solid fuel in the form of coke is more generally used in this country. Its use is not limited to any one type of furnace. The popularity of this fuel is mainly due to the comparatively low cost of fuel, although, to some extent, the greater experience that foundrymen have in the use of coke adds to its popularity. Probably the most familiar type of furnace in which coke is used is the pit type, a section of which is shown in Fig. 1. These are usually arranged in batteries in which each furnace is a separate unit connected with one flue. The most common type is actuated by natural draught, but in some of the more modern pit furnaces preheated air is supplied.

The firehole in these furnaces may be either square or round. The latter is considered to be more economical in fuel, and gives a better melting ratio; on the other hand, the square hole offers better facilities for stoking, with less damage to the crucible. The coke must be more carefully graded for round fireholes. When the fireholes are dimensioned to suit various sizes of crucibles, as they ought to be, then it is customary to make the smaller ones square, while the larger ones are circular. These furnaces are admittedly low in efficiency, but this is largely due to the use of a substantial bed of coke upon which the crucible rests which is so frequently used, and from which much of the heat is generated in the flues instead of in the fireholes. There is the further disadvantage of this method that the crucible is dependent upon the coke surrounding it for keeping it vertical, as the bed varies with the combustion. This is not very satisfactory, and frequently results in loss of metal. The use of dampers for adjusting the combustion of the coke and proper crucible supports or stands increases the efficiency of these furnaces, and especially so if the air is controlled and preheated with the waste heat.

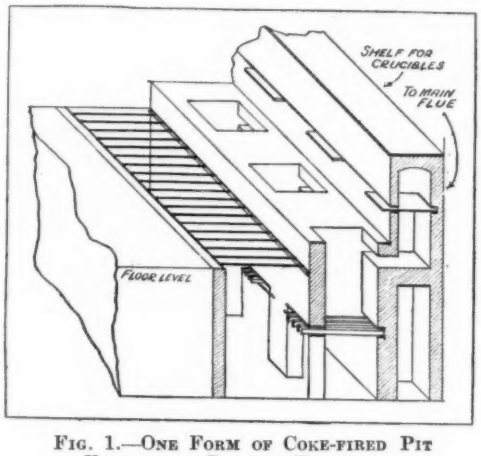

FIG. 1.—ONE FORM OF COKE-FIRED PIT FURNACE IN BATTERY FORMATION.

The pit type of furnace is useful when the work is limited in size or when many different classes of castings have to be made, necessitating different mixtures of metal. As a rule, batteries are made to accommodate 100 lbs. crucibles, but special furnaces are usually adjoining these for 200 or 400 lbs. crucibles, and in some cases larger ones.

This kind of solid fuel is not limited to pit furnaces, but is also used for lift-out and tilting furnaces. The term "lift-out furnace" may also be applied to a pit furnace, since the crucibles are lifted out, but it more generally refers to a furnace resembling a tilting furnace without the tilting mechanism. Invariably the furnace containing the crucible is lifted from its standard and is used to support the crucible during the time of pouring. The tilting furnace, on the other hand, is generally a stationary furnace, and the moulds are either transported to the furnace to be cast or separate ladles are used to carry the metal to the mould. As a rule, therefore, the crucibles contained in these types are not subjected to wear from tongs, and their life is prolonged in consequence. These furnaces are circular, and made to accommodate a certain size of crucible, leaving sufficient space about it that will allow free combustion of the coke. Air is introduced by means of a blower or fan, and the more advanced forms of these types are supplied with preheated air. The majority of these furnaces carry some form of preheater, by which metal to

complete a charge is heated by the waste heat from the melting chamber. In many cases the capacity of the crucible for taking the charge is increased by an extension piece on the crucible as shown in Fig. 2, and as the metal in the crucible becomes molten and sinks, that carried in the pre-heater gradually falls into the crucible, leaving the extension piece clear to be removed when the furnace is opened.

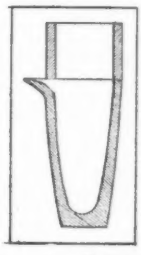

FIG. 2.—CRUCIBLE WITH EXTENSION PIECE.

These furnaces are also installed in batteries, but each is an independent unit. Their capacity ranges from 200 to 1,000 lbs. The advantages they possess over the ordinary pit furnace are, the extended life of the crucible, since it does not leave the furnace, control of the air introduced, quicker melting and larger quantities of a definite composition are more readily produced. It also offers better facilities for controlling the casting temperature. On the other hand, the cost of installation is considerably greater, stoking is just as necessary as with the pit furnace, and therefore the crucible suffers to some extent, varying with the degree of care taken in the process and the manner in which the coke is graded. It limits the size and shape of the crucible that can be used in one furnace. Just as with the pit type of solid fuel furnace, there is a loss of heat and a consequent slowing up of the rate of melting each time stoking is necessary when the metal is in the furnace. These furnaces give a better ratio of metal to fuel, and they are advantageous for providing a similar composition of metal for a number of castings or in dealing with larger castings without the trouble resulting from the use of metal melted in a number of smaller crucibles.

Gas-Fired Furnaces.

The use of gas in various forms as a fuel for crucible furnaces has the advantage of cleanliness, not only in the working of the furnace but in the melting, and it has a considerable range of adaptability, whether the melting is infrequent or continuous. Gas is used in the majority of the types of furnaces, but more particularly with the lift-out and tilting furnaces. In the former crucibles may be located in series in one chamber and the heat supplied from one or two burners, or the chamber may be circular in shape, similar to that used for solid fuel, but the space between the crucible and chamber is reduced for economical reasons.

The design of gas fluid furnaces, the burner and the mixture of air and gas introduced are very important factors in the economic working of such furnaces. It is important, for instance, that the flame should not be directed against the crucible, otherwise it will be greatly reduced about the place of impingement. The surface should be so constructed that the flame enters tangential to the circular chamber, so that it can circulate about the crucible and provide regular heat from the bottom upwards. The kind of burner that is most satisfactory is a debatable point, but variations are necessary according to the kind of gas being used. Burners carbonise to some extent in use, and must be examined periodically and cleaned.

It must be capable of a wide range of adjustment, because even in the case of town gas the heating value, as well as the pressure, changes from time to time. It is therefore necessary to modify the mixture of air and gas to obtain the most efficient flame, and at the same time the right combination of air and gas must be watched very closely in order to protect the crucible, particularly if a graphite crucible is being used in the furnace. Too much air in proportion to gas will reduce the life of the crucible, while an excess of gas reduces the temperature of the flame, and therefore the efficiency of the furnace. When gas furnaces are well regulated the life of the crucibles is prolonged, the temperature can be effectively controlled, and as no stoking is required, with the consequent loss of heat, the metal can be more quickly melted than with solid fuel. These furnaces have a capacity ranging from 200 to 1,000 lbs. The high initial cost of many gas-fired furnaces and the cost of the fuel used should be considered, with any advantages they may possess. The melting efficiency of a furnace has an important bearing on its relative value, but comparison is difficult, because the efficiency depends upon the amount of superheat which may be imparted to the metal before pouring and the number of continuous heats that may be made. The condition of the metal and the loss experienced in melting must also enter into any comparisons, and under good conditions gas is cleaner and more satisfactory in this respect than solid fuel.

Oil-Fired Furnaces.

The use of oil as a fuel is a great convenience for both tilting and stationary or lift-out furnaces that are used in the brass foundry. It is also used for rotary furnaces that do not involve the use of crucible, and, to some extent in reverberatory furnaces. Heavy oil is used under pressure to ensure a steady supply, and air, either under high or low pressure, can be introduced, according to the burner used. It is frequently used in preference to gas because the cutting action on the crucible is not so pronounced. In other directions its use possesses similar advantages to gas.

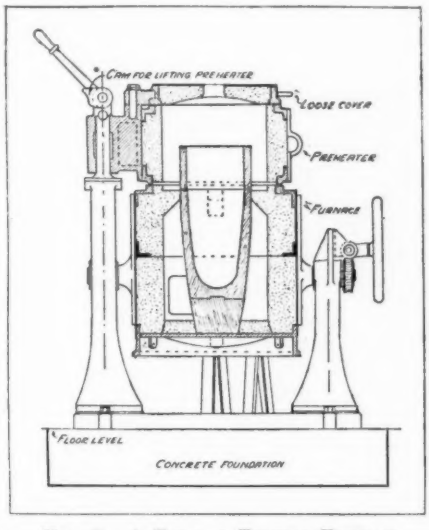

FIG. 3.—A TYPE OF TILTING FURNACE FOR GAS OR OIL FUEL.

The design of the furnaces is similar, but necessitates different forms of burners. Fig. 3 shows a gas- or oil-fired tilting furnace.

Both furnaces have this in common, and may be considered favourable in comparison with solid fuel furnaces in that the fuel is only burned when needed. Directly the metal is in a condition to pour the consumption of fuel is stopped; they give a greater output, and little time is involved tending them, thus there is a reduction in labour costs, the temperature of the furnaces is under better control, therefore better metal is likely to result, and seeing that there are less fumes, it is not likely to be contaminated to the same extent as when coke is used, there is no stoking, and therefore no loss of heat due to radiation at the time of stoking and incidentally they economise floor space.

Although these are undoubtedly advantages, they largely depend upon the personal factor, and unless some time is taken to familiarise the furnaceman with the proper working of these furnaces, especially concerning the right combination of air and fuel, they are nullified, and the furnace becomes a really costly melting device.

The rotary furnaces to which casual reference has been made are cylindrical drums supported horizontally in such a way that they can be rotated. They are lined with refractory material, against which the metal comes in direct contact. Either gas, oil or electricity may be used, as with

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the crucible, tilting or stationary furnaces. The metal to be melted is charged in the furnace instead of the crucible, and when melted the furnace is rotated and tapped from the spout, the moulds being either transported to the furnace for casting or the metal carried in prepared ladles or crucibles to the moulds. The flame from the burner or burners comes in direct contact with the metal, and even greater care is necessary to ensure a correct combination of air and fuel than with the crucible types. This type does not meet with much favour in this country. Reverberatory furnaces, for which solid fuel is used in the form of coal, as well as oil, are more especially employed for dealing with large quantities of metal without being contaminated with the fuel. This is frequently referred to as an air-furnace, because it depends upon natural draught instead of pressure from a fan or blower. Such a furnace carries a low arched roof, which deflects the heat to the metal charged on the hearth. The firegrate is separated from the hearth by a refractory bridge, which forms a reservoir for the fluid metal and protects it from the direct influence of the flame. This type of furnace is more convenient for large castings involving some tons of metal.

Electric Furnaces.

The application of electricity to the melting of metals in the brass foundry has made little progress in this country. This is mainly due to its relatively high cost. Electric furnaces are more frequently used for non-ferrous alloys that are to be rolled rather than for the production of castings required as such. A cleaner alloy is produced, and this compensates for the additional cost of melting when it is to be rolled. Arc furnaces are more generally used for this purpose, although the arcs are not usually in direct contact with the metal. There is, however, considerable oxidation when the zinc contents exceed 20 per cent. The upper walls of the furnace become exceedingly hot, and invariably rocking or other movement is resorted to so that the metal will cool them. With non-ferrous metals the electric resistance is usually low, too low to obtain the best results from an induction furnace. Another type of electric furnace, however, is heated by the transference of heat from a resistance material through which the current passes. The resistance forming the retainer, the heat is distributed uniformly. Some of these furnaces are crucible furnaces, the crucible forming the resistance, although they are usually insulated to protect the metal. With cheaper power no doubt greater use would be made of electric furnaces, because they offer that advantage of cleanliness from foul gases and offer better facilities for melting under a neutral or reducing atmosphere.

Melting Practice.

The various alloys are prepared in the first place from the virgin metals and cast in ingot moulds. It is important to remember that those metals that have the highest melting points should be melted first, and other metals introduced in the order of their melting temperatures. The additions to form the alloy should be made gradually to reduce the chilling action on the base metal, and when the quantity to be added to the base metal is considerable it is better to introduce only a part in this way, the remainder being melted separately and added in a molten state. The mixture should be thoroughly stirred before pouring into the ingot moulds, and at the time of adding the pieces of metal. Allowance should be made for volatilisation and oxidation when adding metal. Zinc, for instance, added to copper is reduced about 10 per cent. by volatilisation, and tin oxidises when introduced into copper, although phosphorus assists in counteracting this tendency. Copper should be melted under charcoal to prevent oxygen being absorbed. In making up mixtures for actual casting the analysis of both ingots and scrap should be known, and it is always necessary to make allowance for loss of zinc that may be in the mixture.

MR. S. H. JOHNSON recently read a paper on "Weighing in Bulk" before the Manchester Association of Engineers, in which he described various types of automatic weighing machines.

Company News.

Samuel Marsden & Sons, Limited.—Dividend on ordinary shares for year passed.

North Lonsdale Iron & Steel Company, Limited.—Dividend, 2 per cent., less tax, for year.

Marston, Thompson & Evershed, Limited.—Interim dividend on ordinary, 1s. 6d. per share net.

Platt Brothers & Company, Limited.—Interim dividend, 5 per cent., less tax, on ordinary.

United Wire Works, Limited.—Dividend, 7½ per cent., free of tax, on ordinary for year; carry forward, £5,252.

C.V. Aluminium Syndicate, Limited, 8, Drapers Gardens, London, E.C.2.—Capital £1.000. Secretary: P. Grout.

W. H. Dorman & Company, Limited.—Loss, £47,012 for year; carry forward, after deducting small credit balance brought forward, £47,002.

Ashby & Anderson, Limited, Hillidge Foundry, Hunslet, Leeds.—Capital £2,000. Ironfounders. Directors: Mr. J. Ashby and Mr. R. Anderson.

Harmer Engineering Company, Limited, 8, Bank Street, Gravesend.—Capital £1,500. Directors: D. W. Fairweather (chairman), S. Mallock and Mrs. J. O. Fairweather.

Steel Company of Scotland, Limited.—Dividend, 5 per cent., less tax, for year; depreciation of colliery plant and exhaustion of minerals, £3,000; balance, £57,847, carried forward.

Hordern, Mason & Edwards, Limited, Vulcan Works, Vesey Street, Birmingham.—Capital £16,000 in £1 shares. General engineers. Directors: A. W. Hordern and W. G. Edwards.

MacCulloch & Morton, Limited, Glenburn Engineering Works, Ingleston Street, Greenock.—Capital £2,000. Iron and brass founders, etc. Directors: R. M. MacCulloch and W. M. Morton.

Mineral Deposits, Limited, 17, Mincing Lane, London, E.C.—Capital £2,100 in 2,000 £1 10 per cent. cumulative preference and 2,000 1s. ordinary. Directors: E. J. Byrne and E. G. D. Byrne.

Birnwell Iron Company, Limited, 1, Regent Street, London, W.1.—Capital £575 in 500 cumulative preference shares of £1 and 1,500 ordinary of 1s. Directors: R. H. Whittington, F. A. B. Simmonds and R. H. Cross.

Rogers Construction Company (1923), Limited.—Capital £30,000 in 25,000 cumulative participating preference shares of £1 and 100,000 deferred shares of 1s. each. Directors: W. du Cros (director, Spencer (Melksham), Limited) and R. Rogers.

Chubb & Colmer, Limited, 69, Aldersgate Street, London, E.C.—Capital £2,000 in £1 shares (5,000 A ordinary, 1,000 B ordinary, and 500 8 per cent. preference), to acquire the business carried on as the Anglo-American Metal Company. Directors: G. C. P. Chubb (permanent managing director), W. E. Colmer and H. D. Candish.

Shotts Iron Company, Limited.—Balance brought forward, £44,695; reserve, £20,000; sum at credit of profit and loss account, £42,270; total, £86,966; dividend on preference for second half-year, 2½ per cent., less tax, making 5 per cent. for year; dividend on ordinary, 10 per cent., free of tax on old shares, and one-third of 10 per cent., free of tax, on new shares; carry forward, £58,058.

Silica Bricks.—In the course of a Paper on "The Commoner Refractories," read at Birmingham before the University Metallurgical Society recently, the author, MR. E. E. MOORE, dealt at some length with the advantages of the pure silica brick. The silica brick required careful treatment during heating and cooling. It did not deform as a rule until a temperature of 1,500 deg. C. was reached, but at that point the deformation was apt to be sudden. An increasing quantity of semi-silica bricks were coming into use containing 80 per cent. of silica, which for some purposes were quite suitable, as, for instance, for coke ovens. The essential elements of an efficient refractory were that it would resist slag and compressions at alternations of temperature; also it would stand up well to cutting flames and the impact of gases. The speaker showed by diagrams the superiority of the silica brick to the ordinary fireclay brick, especially in its resistance to deformation. On the other hand, it was much more susceptible in respect of rapid changes of temperature, and therefore must be heated carefully because of the critical temperatures. Silica would melt at 1,750 deg. C., but under compression the temperature involving failure would probably not exceed 1,650 deg. C. A point of greatest importance was that in the manufacture of the bricks the highest possible temperature should be employed so as to prevent failure at high temperatures after the brick had come into use.

The Manufacture of Ferro-Alloys.—IV.

By J. A. Holden, M.I.Brit.F.

ELECTRIC FURNACE FERRO-TUNGSTEN.

The smelting of ferro-tungsten in electric furnaces requires a plant involving a large capital expenditure, the output from which is small in tonnage. This, it will be observed, is the opposite of the thermit process, described in a previous article, which is characterised by the simplicity of the plant and the rapidity of production attainable.

Small single-phase furnaces provided with a conducting hearth may be used. There are several difficulties with this method, which, however, are not insuperable. There is the question of single-phase supply, which, when not available—and this is not unusual—means that three furnaces must be employed, each of which is connected to one phase of a three-phase supply. To accelerate production, and also to minimise the duration of out-of-balance loads, it is desirable to have each furnace duplicated, so that when a charge is smelted the duplicate is immediately brought into commission. This, of course, does not necessarily mean the duplication of the whole of the electrical gear, for the second furnace may be only the body portion, either mounted upon a bogey or fixed. In the latter case, the top electrode and the bottom connection leads can be sufficiently flexible to permit of connecting up the new unit. Even this method of keeping the load reasonably balanced may not be permissible, particularly if the current is taken from a public power station. The only alternative is then to use a furnace design to suit the available current.

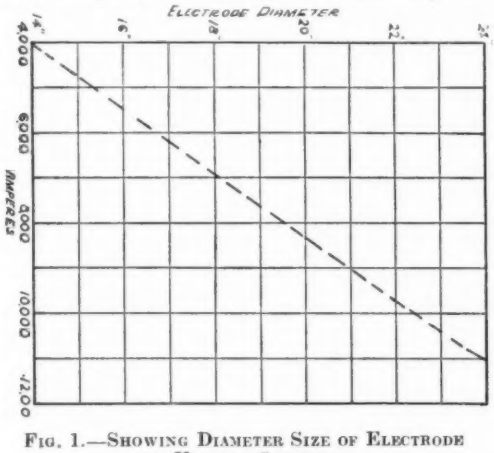

FIG. 1.—SHOWING DIAMETER SIZE OF ELECTRODE FOR VARIOUS CURRENTS.

The choice of furnace is to a certain degree determined by the type of alloy required. Single-phase furnaces with bottom connections require a conductive and highly refractory hearth; as amorphous carbon fulfils these conditions very successfully, it is commonly used. The alloys made in furnaces lined in this way contain carbon up to 1 per cent., with an average of about 0.8 per cent. For many tungsten steels made in either clay crucibles or in electric furnaces this is not a disadvantage. For melting steel in graphite pots, where the carbon absorption is fairly high, it is usually safer to employ an alloy containing rather less carbon. To secure a low-carbon content it is necessary to use another type of hearth. Black "basic" (dolomite and tar) may be employed, and, provided it is rammed in very hard, it will withstand the very high temperature attained in this kind of smelting.

A three-phase Héroult type of furnace offers several advantages. If the electrodes are arranged as in a Héroult steel furnace, the greater part of the furnace top can be roofed; this will help to minimise the electrical and electrode consumption. If desired, the working hearth may also be after the pattern of a basic electric furnace, *i.e.*, made from rammed dolomite; then the alloy will only contain a small percentage of carbon. As in most other ferro-alloy furnaces, amorphous carbon electrodes are invariably used. For one thing, the umbrella effect of the massive electrodes helps to conserve the heat of the arcs; also the fairly rough handling, particularly in continuously fed furnaces, is liable to cause too many fractures with the more fragile and small section graphite electrodes. Although amorphous carbon electrodes, in comparison with graphite electrodes, have low electrical conductivity, they can be obtained of sufficient diameter to carry the currents necessary in ferro-alloy furnaces. To determine the size of electrode required, it may be assumed that a current density of 25 to 30 amperes per sq. in. of cross section is sufficiently high for successful working. Fig. 1 shows the curve from which the size of electrode to use for any current from 4,000 up to 11,000 amps. may be determined.

Operating a plant consisting of three single-phase furnaces, the body portion of each duplicated as previously described, and using 7,000 to 8,000 amps. per phase, with a line voltage of 80, a week's (7 days') output would amount to about eleven tons of 80 per cent. ferro-tungsten.

The wolframite ore is used, either briquetted with carbon and a binding agent such as farina (or potato starch), or it may be fed into the furnace, having been previously crushed and mixed with enough carbon to effect reduction of the tungstic oxide and ferrous-oxide. Unless the ore is very cheap, it is generally an economical proceeding to briquette the charge, because through "dusting," that is, by feeding a powdered charge, losses are certain to be high.

Operating open-top furnaces with briquetted charges, the percentage recovery amounts to 85 per cent. Obviously, this figure would be lower if the charges were not briquetted. On the other hand, by employing a three-phase partly-roofed furnace, the recovery is higher, amounting to 90 per cent.

The power used in a ferro-tungsten furnace is the chief item in the cost of smelting. As the reduced alloy is never sufficiently fluid to tap from the furnace, it follows that the whole charge has to cool down and the furnace body dismantled after each run. Thus current is used to heat up the furnace lining prior to the smelting of each charge.

For each pound of tungsten in the reduced alloy the current consumption will vary from 4 to 9 kw. hours. The former figure would, in practice, only be attained in smelting a low-grade alloy containing about 75 per cent. of tungsten. In smelting a rich alloy containing 85 to 89 per cent. of tungsten, the current consumption would be from 6 to 9 kw. hours per pound of tungsten reduced.

Australian Anti-Dumping Duties.—Notices have been issued under the Customs Tariff (Industries Preservation) Act imposing anti-dumping duties on many classes of goods from countries with depreciated currencies. Most of the goods affected are German.

Spanish Iron Mines.—The Vizcaya mine owners are disturbed at the competition of Melilla iron ore, which is being offered in England at 1s. 6d. per ton under the price of the Spanish ore, and it is feared that this difference may lead to the closing down of certain mines whose costs of production it would be impossible to reduce.

Private Enterprise in Russia.—The State Economic Committee has ratified a Bill drafted by the People's Supreme Economic Council regulating the conditions for the furtherance of private industrial enterprise in Russia. The Bill will shortly be submitted for approval to the Federal Council of the People's Commissioners as the supreme authority. For the opening of small works employing not more than 10 people with machinery, or 20 people without machinery, no special permission is required, while medium-sized establishments employing up to 100 people with machinery, or 200 people without machinery, must be licensed by the Economic Council of the respective Federal Republic.

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Institute of British Foundrymen.

SHEFFIELD BRANCH.

At the second meeting of the 1923-4 session of the Sheffield and District Branch of the Institute of British Foundrymen, at the Albany Hotel, Sheffield, on October 26, there was a very representative gathering to hear a Paper on "Special Rigs for Loam Work" by the President of the Branch, Mr. John Shaw.

COMMANDER JACKSON, who presided, said the President was giving a Paper instead of the usual presidential address. He (the Chairman) was pleased to tell them that Mr. Shaw and Mr. Macdonald, their secretary, had been to Rotherham and seen several members and other gentlemen interested with regard to the opening of a section of the Institute for Rotherham, and they would hear further particulars about this later on.

MR. MACDONALD said if there were any members who lived in the Tinsley district of Sheffield who would assist them at Rotherham they would be doing them good service. Lectures would be arranged at Rotherham in due course. They could not expect members to come from Rotherham to Sheffield. They appeared to be very keen at Rotherham upon making a start, so it rested with the Sheffield members to help them. Continuing, Mr. Macdonald said the Council had been hard at work arranging a very strong programme, and if they could get Rotherham as a centre, it would mean that their Branch would be considerably strengthened.

MR. JOHN SHAW (President) said he first wished to thank them for the honour they had done him in electing that he should preside over their meetings this season. He could only again promise to do everything to promote the well-being of the Branch. Their Council in arranging the winter syllabus had been guided in their choice by the replies sent in by the members on the questionnaire circular. They regretted that more did not avail themselves of the opportunity of expressing an opinion. They had a good list of Papers, and the only thing required to make the session a most successful one was the co-operation of each member, either by taking part in the discussion or at least giving the lecturer encouragement by attending each meeting. The efforts of their Council and energetic secretary would count for little unless they had their wholehearted support. There was one way in which they could all help, and that was by securing one new member each. That would double their numbers and influence, so "bring a friend along to the next meeting and let him see if it was worth while."

There were two other points he wished to mention: the first was the efforts our University authorities were making to establish classes for foundry apprentices. This had the blessing of both the employers and the trade union, and he knew he was but voicing their opinion when he stated that any assistance the I.B.F. could render they were more than willing to give. Next he wanted to call attention to the vast improvement that had taken place in Sheffield City's Technical Library during the last few years. Some four or five years ago it did not compare at all favourably with towns of much less importance, but to-day it was quite up-to-date, and their best thanks were due to the Chief Librarian and the Library Committee. The way to show their appreciation of this was to make the best use of it.

Special Rigs for Loam Work.

Instead of the usual presidential address he thought it would be of more interest if they took a practical subject relating to their work and threw the meeting open to the usual discussion. In selecting "Special Rigs for Loam Work" he was influenced by the fact that loam moulding had not been dealt with in their syllabus for a number of years, and the knowledge that much good work and many heavy castings had been produced in Sheffield by that method. This meant that there were a number of people there who were quite competent to take part in the discussion. They might not agree with some of the "lay-outs" shown, but their criticism would be very welcome, provided they also stated how they would improve it and why. Destructive criticism, however true it might be, was of little use to anyone unless at the same time they submitted something better. Mutual help was the main object of their meetings. He proposed to deal with four phases of the subject: (1) A comparison between the cost of loam and dry sand—the point at which, if ever, the cost of the pattern was covered by adopting dry sand. (2) Briefly to illustrate a few jobs for which patterns were supplied and their cost was wasted. (3) Special rigs that on certain work make loam the cheapest form of moulding; and (4) Special rigs for intricate jobs.

Loam or Dry Sand Moulding.

The difference of opinion between moulders on the North-East Coast and those of Scotland was well known. The former swear by the full pattern, pits and dry sand, whilst the Scotch practice utilised loam with skeleton patterns or shickles, as the case may be. In Belgium there was a leaning to the latter method. Personally, he favoured dry sand and a full pattern of several castings were required. Of course much depended upon the price of the patterns, but for condensers, low pressure and intermediate cylinders or similar work, it did not require many off to justify the full pattern.

Mr. Shaw then by means of a large number of slides explained the methods he had referred to. Taking condensers as a type of the work in question, he had had actual experience in three shops working on both methods. He had also seen examples in at least three other large shops. Mr. Shaw showed the usual starting point for either loam or dry sand and a plate with a core seating and bottom flange struck off. Another slide showed the pattern lowered into position and the rings rammed up to the top of the bottom feet. This pattern was not full length, the boss was about half way, it was lagged up to make a condenser, required 6 ft. larger, was 63 in. diameter and 11 ft. long. He next dealt with the bottom half, the placing in of the feet cores, the blacking and the closing operations. Referring to the thirling bar and the method of wedging to the binders, Mr. Shaw stated that the thirling bar was a C.I. wedge-shaped bar. It was the full length of the core, and was drawn out as soon as the casting was set to prevent contraction bursting the casting. Another aspect dealt with was the complete finishing of the core and the methods used for lowering it into the half mould. He next illustrated a condenser being built up in loam, which showed the chest set, and the mould with the bottom plate of the top half in position. He said that so far as his experience went, that in most cases where more than two were required, a full pattern in dry sand paid every time. It had the further advantage that all branches, feet, etc., could be checked before any moulding was done. They had also to remember the time the pattern-maker was in the foundry setting the various feet, with two or three moulders standing whilst he did it.

The Provision of Useless Patterns.

A number of cases came before him a few years ago where the cost of the pattern was lost entirely, and he had no doubt that the cost of the timber alone was more than the entire moulding cost in loam. This he illustrated by showing a view of a flywheel, and said that when flywheels exceeded 10 ft. it was better to make them in loam from every standpoint. The view showed the starting point for a 20-ft. flywheel. A seating was struck for the arm cores, which were made in halves to facilitate finishing and blacking. These, together with the splitting cores, were set out and the outer rim built up to halfway. A special rig was used to obtain the requisite amount of oval to compensate for the cores and the machining allowance. The whole mould was above. The outsides were rammed up in strong steel curbes, bolted together. This facilitated quick stripping and clearing away. The outside could be used again if more than one wheel of that type was

required; it would only need striking up. Loam could often be used for obtaining an iron pattern that would not only be costly, but weak, if made in timber. Some time ago he made two dished cover patterns in this manner. One was 5 ft. 6 in. dia. by 9 in. deep, the second 6 ft. 8 in. dia. with a 12-in. dished centre. Extra care was taken in moulding and finishing, holes for fastening the ten branch patterns as well as the rapping and lifting holes were cast in. These patterns never went into the fitting shop, but were carefully fettled. The pattern-makers fitted the 10 branches in position. Under these conditions the covers could be made more cheaply in sand, if a turnover board and boxes were provided. Sixty-eight were made off the smaller size and 21 off the larger. For the same job a three-wing propeller, or mixer, was required. The diameter was 3 ft. 6 in. and 12 in. pitch. There again loam was used to produce the pattern, but the castings off this pattern were made in sand. He mentioned this to show that a little thought on these lines would at times save both time and money and result in a better job.

Special Rigs for Cheapness.

Often by the use of a special lay-out some jobs could be made more cheaply and better in loam than by any other method. Some years ago he was asked to make a number of slag pans. These were offered at a price. The firm which had the order previously was making them off an iron pattern in dry sand, and lifting out the core with the top part and finishing overhead. Under these conditions they took three days each of nine hours for two men. They were laid out for loam off an iron skeleton pattern.

As he should use the word "casing" frequently, he explained this meant "an iron mould the same shape as the required casting. In the slag pans a core and outside casing were made allowing for ¾ in. of loam in each case. The outside casing was cast in halves so as to open to lift out the casting. This was necessary owing to the four projecting bottom feet. The roughing coat of loam for the core casing was applied as soon as it was taken out of the hot casting next morning, the latent heat drying this loam. After the outside casing was wedged together, and after taking out the casting, the core was ready for slipping. This done, the iron frame was turned over and lowered into the outside casing. Four-thickness pieces gave the correct thickness. Seatings for the bottom feet cores were struck. These cores were fixed in the bottom pockets and set to marks on the frame. The remaining space in the pocket was rammed up in dry sand. The roughing coat was then put on, strickles working off the inside of the frame giving the correct shape. The four top feet, which were iron patterns, were bedded into marks on the frame, as also was the spout. There again the latent heat contained in the iron casing was sufficient to stiffen the loam to receive the slipping coat of loam. The frame was then withdrawn together with the top-feet pattern and spout. After finishing the mould, a firegrate was lowered into the outside casing, the core casing being put over the top with packings between to give a circulation. In the morning both were dry.

The first thing now was to dress and black the core and cope. The core, as soon as the blacking was dry, was turned over on a bank of sand. Guide marks were next cut in four places on both core and outside. The spout core was placed in position, supported on the back end by chaplets. The core was then lowered in, and a runner box put on one long side with five runners. The finished slag pan was 7 ft. × 3 ft. 6 in. × 3 in., and weighed 45 cwt. A youth cast one every other day with ease, or in a third of the time by the other method. If any of them were tempted to use casings for a job there was one fundamental thing they must remember, that due to the cooling effect of the iron casings, the core must be eased at the first possible moment. This casting was 3½ in. thick on the bottom, tapering up to 1¾ in. on the top edge. Yet if more than fifteen minutes elapsed after casting before lifting the core casing, it was touch and go if you got it out. The core casing was never lifted out, but just started about 2 in. and packings placed in the joint.

The second example under this heading was a series of 98 half-pipes 4 ft. dia. × 6 ft. long, with external bracketed flanges at the ends and internal flanges down the sides. Inside and outside casings were made, the end sections showing how the internal flanges were dealt with. The core casing was made up of four pieces. A bottom plate to which was fastened a D-shaped casting, and two loose segment pieces. After the D-shaped casting and the bottom plate had been bolted together a semi-circular plate 4 ft. dia., with projections half way, was bolted to the casing. These projections were used to guide the straight edge that strickled off the joint. To complete the half circle of the casing the two segment pieces were cottered to the D-shaped casting. The method of procedure was as follows: When the core casing was withdrawn from the recently cast pipe, it was lowered with the swivels on to a pair of tressels and turned over. The level joint was then struck. The casing being hot, the joint dried whilst the moulder was roughing the top part of the casing. The joint being sufficiently dry at this point to carry the two cast-iron flanges, the two segment pieces were cottered to the main casing, these allowing a space of about 1½ in. which was rammed up with core sand, thus forming the other side of the flange. The circular parts of the segment were then rough-loamed over and left to skin-dry while the cope was struck up. The core was then slipped and stoved. In the morning the internal flanges were drawn and the core blacked. Two cope casings were used with semi-circular ends taken out of winding and with spindle holes in each. The striking board was shown resting on the top of the core casing. The bolt holes and brackets were made in three segment cores, the latter dropping into a recess formed whilst the body was being struck up. A man made and cast one of these pipes each day of ten hours, for which he received time and a-half. All pans or pots, if there were sufficient to pay for the outlay, could be made in casings at a quarter of the cost of any other method. A saltcake pot was made at the rate of one per day year in and year out for over ten years by a moulder, a boy of 16, and one labourer. They made eight per week for short periods of a month or so, and weighed approximately seven tons.

In the next example dealt with by Mr. Shaw, the pan was about 5 ft. 6 in. dia. × 5 ft. 6 in. deep, standing on four feet and had four branches on the top. In this case the outside was bricked up permanently in cast-iron rings, with recesses to receive the feet. These feet were made in cores. Seatings were struck by the seatings board, and the cores set with a jig over the spindle that set all the feet at once. The clearance between the feet cores and the casing was rammed up in dry sand. The body part was then struck up. The bottom centre was permanent, whilst the top cross bar fitted to two stands fast to the outer casing. The core was made on a casing giving ¾ in. of loam. The top centre was permanent, a piece of loam protecting it during casting. The outer flange of the core casing was turned and a hardened steel flange on the board worked against it. No gauge stick was needed. Here again the latent heat dried the roughing coat. A moulder and his labourer every three days of nine hours made one of these pans.

Mr. Shaw next explained the lay-out for 20 pans that formed the bottom for gas producers. These bottoms were split into four segments. A man and his labourer made a complete ring every five days.

Special Rigs for Intricate Work.

The condenser previously referred to had the middle portion both larger in diameter and eccentric to the ends. In this case they simply made the striking board about 4 ft. back, and dovetailed the actual striking edge on, in three loose pieces, two to strike the 6 ft. piece top and bottom with the flanges, the third to strike the larger diameter piece in the centre. The vertical spindle fitted into a double top and bottom centre with holes the right distance apart. The bottom flange seating and the 6 ft. portion of the body were struck up first. Then the whole board and spindle was moved into the second centre and the portion built and struck up. It was then neces-

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sary to move the board and spindle back to strike the top portion and top flange. The loose middle-striker was taken off before this was done.

To strike a mould oval, to allow for splitting cores, several methods were in use. For some years he employed an eccentric block fastened to the stationary spindle to a centre line, the arm fitting the eccentric. One half was built up so far and then the eccentric block was reversed to strike up the other half. A sliding block with a centre in the middle was frequently used. This block fitted into a heavy bottom plate, and the former was moved a definite amount to allow for cores as each half was struck up. The method he had found the best was shown on the slide before them. By it they could strike a mould that could be divided with cores into two, four, or six equal parts. The spindle was stationary. On it, at a suitable height for the job, was screwed a cam plate as required. The arm fitted the spindle and rested on the cam plate. In it there was a machined slide, often fitted with V grooves like a slide-rest. The end of the arm fitted into this groove. It had a bracket cast on to receive a hardened steel roller, and this roller fitted into the cam-plate groove and moved the sweep in or out in accordance with the groove. The making of the cam-plate required care in moulding, because the groove was only cleaned out but the whole in the centre was bored out and boss faced.

A Rig for Conical Drums.

The whole rig when in position was quite a good device if they did not expect too much from it. It had the great advantage that one could build it right up without reversing. There was an allowance for a 2-in. core and $\frac{3}{8}$-in. aside for planing.

For striking up a conical rope drum, which had the drums fastened together when at work at the large end. A steel shaft runs through the whole. The small ends were the starting point for the rope, the smaller diameter giving the motor a better chance at the start. The drum was about 3 ft. at the largest end. The whole rig for this was of metal. The main spindle was fast and had a screw cut in it to the required pitch. The top and bottom arms were connected together by a round bar. The nut was cut to suit the pitch on the spindle. The top holder was connected by rods, which worked an easy fit through holes in the nut. The action of the rig was, as the arm moved round so that they worked the nut up or down according to the direction, which also brought the tool holder up or down as the case may be. The rods were forced to follow the guide.

Mr. Shaw finally dealt with a most intricate and complicated rig used for a series of winding drums for the Wellman, Smith Owen Corporation. The combined cylindrical and conical hoisting drum was 16 ft. dia. at the large end and 10 ft. at the small end. The conical section was very flat and increased from the small to the large in four revolutions. The spindle was 6 in. dia. and had a variable screw cut in. The material used was hard wood. The sliding arm, with the aid of the rollers, was allowed to travel or slide freely. The gear at the top was attached to the spindle with a feather key, permitting it to travel up and down the spindle as the frame was raised or lowered. As the frame was revolved round the spindle a gear drove the wheel, which by means of a shaft pinion and rack caused the sliding arm to travel radially backward or forward as the case required. The raising or lowering of the frame was governed by the engagement of the conical roller with the thread in the spindle. The bracket was located to the lower part of the frame.

After the seating and flange were struck and dried, a wooden flange was dropped in segments. The frame was placed in position and the bracket fastened in the right position for the conical roller to fit the bottom of the screw cut in the spindle. For striking the small parallel part the gearing was thrown out. The arm with the small strikle attached was set by the gauge stick to the correct diameter and locked. This part was then roughed up, the fine thread in the spindle giving the pitch. When the height came to the conical point, the gearing was thrown in the strikle attached to the arm. Through the gearing the arm and strikle travelled outward as the frame revolved. Coming to the top parallel part the gear was again thrown out and the strikle set to the gauge stick and locked. The remaining grooves were swept up according to the pitch of the screw on the main spindle. As the changing of these cutters and pitch of scoring was rather abrupt, a little mending at these points was required. After the mould was dried a thickness was applied to give the shape of the core. The various brackets and arms were set, and the core was then built up, lifted out, dried and blacked.

DISCUSSION.

THE CHAIRMAN said they had all been most interested in the lecture, and submitted that there was plenty of opportunity for an exhaustive discussion.

MR. EDGINTON said the lecturer referred to the Belgians working with scarcely any pattern, but to his mind that was false economy. To get four or five moulders round a job with different opinions as to making it spelt disaster. In the special rig shown for sweeping conical drums, instead of the cam arrangement he, the speaker, used two holes pitched $\frac{3}{4}$ in. apart, and the spindle is lifted from one to the other with very little loss of time.

MR. F. DARLEY said some years ago he was working in a small iron foundry, when they received an order for four spiral drums about 6 ft. 6 in. dia. ×4 ft. 6 in. wide, suitable for a $1\frac{1}{2}$-in. dia. rope. These were struck up in loam with a board made to strike the whole thread at one revolution. The board was balanced by means of a crosshead and pulleys on the top of the spindle. The travel of the board formed the thread of the spiral, and it was guided by means of a spiral footstep at the bottom of the spindle. This footstep was cut out of hard-wood to the correct pitch required. The board was run once round the job from the bottom to the top of the spiral (striking the whole width of the drum), and then dropped down to the bottom level again, and run up to form the finishing sweep. This meant that the part cut through the threads of the loam by dropping the board required to be made up and finished by hand after the board was removed. Two were made (right and left hand) and were a distinct success. They were exactly the same diameter, which was an essential. With the exception of the spindle and arm to carry the board, all the tackle was made of wood by the pattern-maker. Condensers for marine work are generally struck up from a skeleton frame constructed to give the outline shape with the columns and feet fitted on in wood. He remembered making some large round condensers in brass about 7 ft. 6 in. dia. and 5 ft. 6 in. long, with feet and branches cast on. These were struck up in loam. In forming the core, three cast-iron wedges were built up in the core, and immediately the job was cast the wedges were drawn out by the overhead crane, thereby releasing the core and allowing the castings to contract freely. These castings were only $\frac{3}{4}$-in. thick and were all made successfully, which probably would not have been possible without some means of relieving the core immediately after being cast.

Clay Boards.

MR. J. LIVERSIDGE said that in considering the cost of pattern-making on a particular job, one can sometimes eliminate either the cost of loam boards or full patterns by the use of a clay board. Where the cost of making a pattern and corebox would be prohibitive, by the use of clay and the old casting, one can produce an accurate casting, thereby cutting out the pattern shop entirely. Loam boards he called an evil necessity; but there are some jobs where boards are very economical. For instance, the top part of a round plate could be rammed up and treated in such a manner that it would last for, say, a dozen moulds, and in that case no one would go to the expense of a full pattern. It is astonishing what can be done with the use of clay in a foundry.

THE AUTHOR'S REPLY.

THE PRESIDENT, in reply, said Mr. Edginton had referred to the false economy of the Belgians, and he agreed with him to a great extent. He

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.

THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS (MANCHESTER), LIMITED.

BLACKFRIARS, MANCHESTER.

had seen a good deal of Belgian work, and could say that they turned out some good work, but at the same time he thought they carried it too far. They were the finest set of moulders he had encountered. There was no belittling their own work, and a man could read his drawing. Mr. Darley referred to a spiral drum, and if the whole of the grooves were struck up at one revolution the moulder would have to depend upon the race as in striking up a propeller.

Continuing, the President said that for large work much depended upon how many castings were required. He had found on certain work that if more than two were ordered it paid to make a pattern.

MR. J. R. HYDE said they had benefited very much from the President's able remarks. One admired the skill in the moulder's art which they practised. He noticed that some of the methods described showed considerable engineering skill. It was evident that the President and others who designed these rigs must have had some knowledge of engineering. The increased accuracy now attained compensated for the extra cost entailed. He proposed a hearty vote of thanks to Mr. Shaw for his lecture.

MR. AMBROSE FIRTH seconded, and it was carried with acclamation.

THE PRESIDENT acknowledged the compliment, and the proceedings terminated

"Moulders" of the Industry.—No. 22.

Mr. J. Smith.

Mr. J. Smith, the President of the Newcastle Branch of the Institute of British Foundrymen, was apprenticed in 1878 as a green-sand moulder at the Whessoe Foundry, Darlington, which at that time was making locomotive and general castings. During this period Mr. Smith helped to mould some of the coat-of-arms castings for Hammer-

MR. J. SMITH.

smith Bridge. At the age of twenty, in 1887, Mr. Smith thought it desirable to gain experience in other branches of the industry, and joined Mr. James Black at the Portobella Foundry, Sunderland. This was a large foundry, turning out castings up to 20 tons. At this period, like many others, the foundry was changing over from loam to dry sand for the making of marine engine castings. It was customary when making the large cast-iron cases, measuring from 7 to 16 ft. square, to place them in the foundry floor at a depth of 7 to 9 ft. for the making of dry-sand moulds. The loam floors and stoves were then only used for the making of large cores, which undoubtedly speeded up the work.

After eight years with this concern, Mr. Smith transferred to the foundry of Mr. William Black, at South Shields. After two years, Mr. Smith was made chief foreman, which position he retained for twelve years, making marine, turbine, locomotive and general castings weighing up to 30 tons. At that time marine turbine engine building was in its infancy, and the difficulties associated with such conditions occupied much of his time. It is interesting to note that Mr. Smith made the first turbine castings for the "Virginian," the first passenger steamer to be engined with Parsons turbines.

In 1909 Mr. Smith entered into partnership with Mr. Edward Smith, of South Shields, who at that time had a small foundry making castings up to 4 tons weight. A new foundry was designed and built adjoining the old shops. It is 300 ft. long by 50 ft. wide, and has tackle for making castings up to 20 tons. The firm—Messrs. Smith & Company, Limited, Holborn Foundry—is situated in Nile Street, South Shields, and is one of the best-equipped foundries of its size on the North-East Coast. It is spanned by 30-ton, 20-ton, and 10-ton electric overhead travelling cranes. It has only recently been converted into a limited liability concern, when Mr. Smith's son, Mr. Robert Smith, was appointed manager and included in the directorate.

Mr. Smith joined the Institute in 1905, and gave his first lecture at the Newcastle Convention in 1905, dealing with the making of marine engine castings in both dry sand and loam. It was much appreciated locally, and was repeated before many technical societies in the North of England. Mr. Smith's views on the progress of the foundry during his thirty-five years' close association with it are obviously interesting. He recently stated to a Press representative: "At the beginning of my career analytical chemists were unheard of in connection with the foundry trade. When they were first introduced, about twenty years ago, they were not taken kindly to by many foundrymen; I myself was prejudiced against them. The reason can be ascribed to the numerous unsuccessful experiments and disastrous results. This prejudice has died, and it is now proved that a good foundryman working with a good chemist can obtain much better results than previously. Owing to the higher standard of material required to-day, the best possible results are essential."

Contracts Open.

Hitchin, December 7.—Supply and erection of steam-driven centrifugal pumping plant, for the Hitchin Urban District Council. Mr. W. O. Times, clerk, Town Hall, Hitchin.

London, E., December 10.—Piping, valves, pumps, etc., required in connection with Abbey Mills pumping station, for the London County Council. The Chief Engineer at the Old County Hall, Spring Gardens, Charing Cross, S.W.1. (Fee, £5, returnable.)

London, E.C., December 7.—Six brass-finishers' capstan lathes, for the Bengal-Nagpur Railway Company, Limited, 132, Gresham House, Old Broad Street, London, E.C.2. (Fee, 10s., non-returnable.)

London and Australia.—The Commonwealth of Australia require brass rod and sheet and nickel (10.12.23), cable terminal boxes (15.12.23), telephone and telegraph apparatus (3.1.24), air compressor, etc., for automatic delivery of telegrams (4.1.24). Supply Officer, Australia House, Strand, W.C.2.

THE MEMBERS of the graduates' section of the North-East Coast Institution of Engineers and Shipbuilders visited the engine works of the Palmer Shipbuilding & Iron Company, Limited, Jarrow, recently.

THE SHAREHOLDERS of Thos. W. Ward, Limited, recently decided to increase the capital of the company to £1,350,000, by the creation of 250,000 new shares of £1 each. The directors are now issuing 125,000 new 5 per cent. second cumulative preference shares free of tax, and 125,000 new ordinary shares, both at par, and to give to the holders of the existing first preference shares, second preference shares (but not employés' shares) and ordinary shares of the company the opportunity of subscribing for the new capital in the proportion of one new second preference share and one new ordinary share for every eight shares held.

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Box and Mould—after being Rammed—in position of being Rolled over.

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Pattern plates can be changed instantly without unfastening mechanism so that comparatively small quantities can be made economically.

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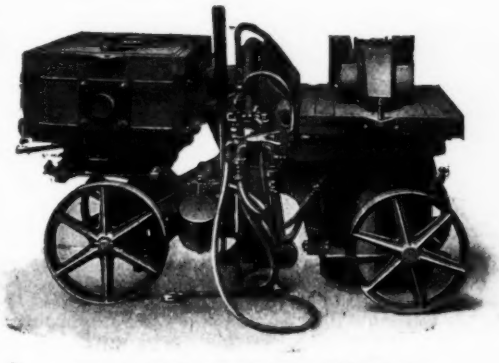
All moulds jar rammed in a few seconds and thoroughly uniform in density, ensuring minimum quantity of defective castings and less blow holes.

"All operations other than sand filling are completed in two minutes for any size of work within capacity of machine. To realise what this means, compare your present wage cost for the same work!"

CAPACITY.

SIZE	* Size of Moulding Box.	Straight Pattern Draft.	Nett Weight of load that can be rolled over at 80lbs. pressure.
18	18 in. wide. 36 in. long. 12 in. deep.	8 in.	450 lbs.
24	24 in. wide. 48 in. long. 15 in. deep.	10 in.	800 lbs.



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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Movements in the Cleveland iron trade during the current week are again favourable to a continuance of the recent improvement in buying, a steadily active business passing, especially in foundry pig, which indicates an increased demand, due naturally to the reopening of consumers' works on the termination of the prolonged boilermakers' dispute. There is also growing strength in buying on forward account, and numerous contracts are being arranged for deliveries over the first quarter of the New Year, the demand quite absorbing the present limited output. The position may, in fact, be accurately described as much more satisfactory than has been the case for some time past, and with the subsidence of the present election excitement there seems a good prospect of a return to something like normal conditions in the trade. Inquiry on export account for Cleveland iron is, however, disappointing, but is hardly surprising when the chaotic state of foreign exchanges is taken into consideration, although the total shipments from Tees-side ports for November show a slight improvement on the month. There has, so far, been no alteration in current quotation, but values are very strong at the previous week's levels, No. 1, which is extremely scarce, ruling at 107s. 6d., No. 3 G.M.B. 100s., No. 4 foundry 99s., and No. 4 forge 98s. per ton. There are now 44 furnaces in blast on the North-East coast, five having been added during November. Of these 44, 14 each are on Cleveland and hematite, and 16 on basic and other kinds of iron.

Quite the strongest section of the Cleveland market, hematite continues in heavy demand for home consumption consequent upon renewed activity in the shipyards, engineering and steel-making branches on the North-East coast, while smelters in this area are also supplying large quantities of this grade iron for users in South Wales and Sheffield. Export trade is relatively quiet, but the current home demand is straining the resources even of the recently enlarged output, and a further increase in production is imminent. Values are slowly appreciating. At Middlesbrough market last week 101s. 6d., or 6d. above the previous quotation, was the minimum price for East Coast mixed numbers, and a 1s. premium was demanded for No. 1. These were only for prompt parcels, mixed numbers for forward delivery being quoted at fully 102s. 6d. per ton. In West Cumberland and North Lancashire also prices are firm, Bessemer mixed numbers being quoted at 115s. per ton delivered at Glasgow and Sheffield, and 120s. per ton at Birmingham.

MANCHESTER.—The market for foundry iron in this district has not as yet been greatly affected by the restarting of the engineering trades, and there is consequently only a moderate demand for pig-iron for foundry purposes. Most of the Derbyshire furnaces are, however, well supplied with orders for the next three months, and there does not appear any trace of anxiety to sell. Makers of iron suitable for local consumption seem quite satisfied; and, indeed, some of them are not inclined to take orders for far-forward delivery, but on the other hand are rather disposed to check buying by asking a premium. Some Derbyshire makers have been quoting 95s. per ton on trucks for No. 3 foundry pig, but this is a rather high price and it is quite easy still to buy the iron on a basis of 92s. 6d. at the furnaces, or, say, at 101s. per ton delivered in Manchester. The demand here for Scotch iron is small, but the price is rather firmer at about 122s. per ton delivered in Manchester.

THE MIDLANDS.—At Birmingham market last week conditions in the pig-iron section continued fairly active, but the demand for foundry qualities has not improved to the extent anticipated, and business in this grade was only moderate in volume. As this is a usual condition at this period of the year, no unfavourable deduction can be drawn from its occurrence, and smelters are apparently justified in anticipating a widespread revival of buying with the resumption of shipbuilding. There are rumours of a South Staffordshire furnace being relighted in the near future, and though at present this lacks confirmation, it is an indication of the way the wind is blowing. There are still two firms whose furnaces have been inactive ever since the last coal strike. Quotations:—Northamptonshire No. 3 foundry, 92s. 6d.; Derbyshire No. 3 foundry, 92s. 6d. to 95s., f.o.t. furnaces.

SCOTLAND.—It is perhaps noteworthy that the restart of work at the shipyards and engineering establishments, following the recent settlement of the boilermakers' strike, has by no means stimulated demand for pig-iron, but this may be explained by the fact that buying on forward account in anticipation of the event has for the time being checked business in this direction. In any circumstances it is probable that the election excitement would doubtless have had a similar effect. However, makers, having now pretty good order-books, are firm in their quotations at 105s. for No. 3 Scotch at the furnaces, but even on this basis the Scotch price is not above that of No. 3 Middlesbrough delivered here, so that either Cleveland iron is too dear or Scotch too cheap, and smelters here take the latter view.

Finished Iron.

In the manufacturing branches of the industry the position is steadily improving, and although necessarily some time must elapse before full recovery is made, work is steadily on the increase in many departments. Prices are firm, but are not at present quotably higher. Throughout the iron market, therefore, a hopeful and confident feeling prevails, and certainly the volume of business seems to warrant this. Some of the makers of best crown qualities are now enjoying much steadier employment, and there is a fair volume of work coming in on account of railway requirements, both for home and export. Foreign competition seems to be rather less troublesome to makers of nut and bolt bars, who have been able to secure an advance of 2s. 6d. Makers of cable irons and similar shipyard requirements are already experiencing an improved inquiry, from which business is expected to result.

Steel.

The outlook in the market for steel again reflects the more active tendency of business offering in the various departments of the industry, and in the temporary absence of serious foreign competition there is a more cheerful tone all round. Soft basic billets are in demand, and although the quotation is generally £8 5s., sales are being made at higher figures. Occasional parcels of continental dead soft billets are offering at £7 7s. 6d., delivered Sheffield. These are reported, however, to be not very reliable for the purposes of most steel rollers in this district, and the buying is very limited. Hard basic billets are slightly more active, as also are acid qualities, but prices are unchanged. A Sheffield steel manufacturer states that, according to a confidential report, the stocks of steel in the Ruhr are intended for this country, and that within the last few days he has seen quotations for this material. In the market for alloys, prices of ferro-manganese are unchanged, but as these were originally fixed to induce buyers to come forward at a time when a considerable falling off was being recorded, it is quite on the cards that the new interest now being manifested will bring with it a reversion to the higher prices quoted for this alloy earlier in the year. More export orders are about, and there is a steady run of small domestic orders. Quite a considerable business has been done during the past week or so in tinplates of all descriptions. The tone of the market is strong, and prices very firm with an advancing tendency. The official minimum selling price is 23s. 6d. f.o.b. Wales, but 23s. 9d. has been freely paid for shipment over the first quarter of the year.

Scrap.

An all-round improvement in the demand for scrap is reported from most centres of consumption, and with few exceptions some hardening tendency is noted in the quotations ruling in the various markets. In Lancashire, for example, dealers are now inclined to ask for an advance for fine scrap, which is certain to be in request for mixing purposes when the iron foundries are active again. Up to the present good cast scrap has been selling at 87s. 6d. to 90s. per ton, or, say, from 12s. 6d. to 15s. per ton less than the cost of common pig-iron, delivered at the foundries. The probability is that when the scrap is required consumers will pay considerably more than this, unless, of course, foundry pig-iron should be cheaper, and of this there is no probability. The improvement in the Scottish pig-iron market is reacting on cast-iron scrap. Inquiries are fairly numerous, but merchants have little or nothing to dispose of. Heavy machinery metal and scrap railway chairs run about 100s., and ordinary heavy cast-iron scrap around 92s. 6d. to 95s. Light cast-iron and furnace firebars quote about 77s. 6d. per ton.

At Sheffield the very sharp demand for heavy basic steel scrap for melting continues, and prices have moved up again. Local users, who kept off the market so long, are now offering up to 95s., but merchants in some cases are refusing to sell at this figure and are asking up to 100s., and talk of getting even better terms than this.

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Metals.

Copper.—After a brief reaction in values, the tendency of standard metal has taken a steadier turn, the close of the week's markets evidencing distinct firmness with quotations at slightly higher levels. The recent improvement in the price of electro was not maintained in New York. Producers, after making good sales at well over 13 cents, found that consumers were becoming frightened by the rapid character of the advance, and in consequence of the lull in buying prices sagged. The failure to maintain the rise in America is evidently a sign that the statistical position of copper is not one which can be readily improved. The demand from consumers in this country remains on a moderate level, while business in manufactured copper has also declined. During October stocks in America were increased by about 8,500 tons, bringing up the total to about 120,000 tons, so there is no doubt that the situation has not yet begun to improve. Current quotations :—*Cash* : Thursday, £62 5s. ; Friday, £62 5s. ; Monday, £62 7s. 6d. ; Tuesday, £62 5s. ; Wednesday, £62. *Three months* : Thursday, £63 ; Friday, £63 ; Monday, £63 2s. 6d. ; Tuesday, £63 2s. 6d. ; Wednesday, £62 15s.

Tin.—Firm conditions continue to rule in the market for standard tin, and notwithstanding some signs of weakening values, advised in Eastern cables, prices on this side are strongly maintained, reaching in fact at one time the highest level recorded since 1920. There has been some fairly heavy buying on American account, while intrinsic soundness of the position is now generally recognised, and values may be well held in the future, despite the placing out of the surplus Eastern stocks. There is no doubt that tin users, both here and in the United States, have been paying too much attention to the possibility of the State-owned tin being a bearish factor. Thus they have been working with light supplies of the commodity. Now that the Government metal already sold has been easily absorbed without disturbing prices so far and the quantities remaining are negligible, there has been more desire to buy tin round about the current level. Current quotations :—*Cash* : Thursday, £233 ; Friday, £236 10s. ; Monday, £238 7s. 6d. ; Tuesday, £236 15s. ; Wednesday, £236 15s. *Three months* : Thursday, £233 10s. ; Friday, £237 ; Monday, £239 5s. ; Tuesday, £237 12s. 6d. ; Wednesday, £237 12s. 6d.

Spelter.—An outstanding feature in recent dealings in this metal has been the fact that the spot metal which had been overhanging the market has been absorbed. The price of spelter has, however, slightly depreciated, resulting in a small decline at the close. Although galvanisers report diminished trade during the last few weeks, there is no doubt that, attracted by the low level which has ruled recently, they have covered their requirements quite substantially. Current quotations :—*Ordinary* : Thursday, £33 2s. 6d. ; Friday, £33 ; Monday, £33 ; Tuesday, £32 17s. 6d. ; Wednesday, £32 11s. 3d.

Lead.—The market for soft foreign pig discloses little change, fluctuations in values having been on a fractional basis all round. All reports confirm that manufacturers of lead products continue exceptionally busy, and as yet there is no sign that the high price of the raw material is encouraging larger shipments. The market for spot lead has been remarkably steady, and the soundness of the situation was further shown on Monday by the quick recovery of 10s. in the forward quotation. Current quotations :—*Soft foreign (prompt)* : Thursday, £30 12s. 6d. ; Friday, £31 ; Monday, £31 10s. ; Tuesday, £31 10s. ; Wednesday, £31 10s.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

The Decline of Semi-Steel.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The letter from "Cupola" and your comments on it confirm the fact that there is a present and limited tendency to use special low carbon pig-iron in place of semi-steel. Your footnote suggestion that this may be due to the increased reliability of the special pig-irons now on the market is probably not far wrong. It should be realised that the making of satisfactory semi-steel requires a combination of metallurgical knowledge and practical experience which is not to be found in every foundry, even of established reputation; and it is not surprising that in these cases the special pig-irons should receive favour, for, although they are relatively expensive, they afford a ready means of obtaining the special qualities necessary in certain castings.

"Cupola's" remark that "surely semi-steel has sufficiently established itself as a reliable, easily made material" may be taken as correct, providing the right sort of control is exercised in its manufacture.

With semi-steel, as in all other directions, there is no royal road to success, and in cases where trouble is experienced, and not overcome, it is probably safer to trust to the special pig-irons.

We may sum up by stating that both products—semi-steel and low carbon pig-iron—have their respective spheres of usefulness, just in the same way as those other great rivals—gas and electricity.—Yours, etc.,

ERNEST WHEELER.

Manchester,
December 3, 1923.

High-grade Low-carbon Cast Irons.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have spent considerable time over the results recorded in your translation of Dr. Wüst and P. Bardenheuer's Paper, as printed in THE FOUNDRY TRADE JOURNAL of November 15, 1923.

With the general conclusions with which the article starts most founders here will agree. Summed up, they are, "That transverse, tensile and hardness tests decrease with increase of the graphite content. By increasing the percentage of carbon and silicon the graphite in the material is coarsened. This shows the importance of the total carbon content."

Turning now to the tables given, and keeping the above conclusions in mind, the results are most confusing.

Table I, melts 1 and 2, certainly shows the lowest total carbons, but also the lowest combined carbons, yet the Brinell numbers (323 and 327) indicate a badly mottled bar, which at the same time gives good tensile results. Melt No. 24, with a CC of 1.65 per cent., gives the highest tensile result, nearly the best transverse result, with a deflection of 0.452 in, yet has only a Brinell hardness of 244. These high CC, coupled with high test results and good deflections, are contrary to the findings in this country.

Table No. II agrees pretty much with British results, the CC being round about the figure given by investigators here. There is also fair agreement as to the effect of Mn on the graphitic structure. It would be interesting to know the size and breaking centres of the transverse bar used in these experiments, as 0.804 in. is too much for the standard German bar.

Table No. III is as confusing as some of the other results. Here the highest TC with the greatest GC also had the lowest CC, 0.32 per cent., yet gave the highest tensile result, practically twice the load of the first of this series.

In Table No. IV again the CC is above the amount we reckon, and yet it gives the greatest strength. It ranges in cast No. 6 from 1.22 to 1.3 per cent. The test results, however, do not equal those given in Tables No. II or V, with their CC ranging about 0.75 per cent. In one respect the results obtained in Table No. IV confirm work done here, viz., that with the reduction of the diameter of the test bar there is an increase of CC and in hardness as registered by the Brinell from bars cast from the same ladle.

Table No. V coincides fairly well with the results obtained here.

Table No. VI does the same, except perhaps a little lower S and P here.

With the summing up I am quite in agreement, viz.: "The essential characteristics of high grade cast iron may be said to be a fine distribution of the graphite, and a *purely pearlitic ground mass.*" Does this last essential go with CC of 1.25 per cent to 1.65 per cent. I should be pleased to have your opinion or those of your readers as to the results given in the tables.—Yours, etc.,

J. SHAW.

39, Montgomery Road, Sheffield,
December 4, 1923.

[A purely pearlitic ground mass is associated with 0.89 per cent. of combined carbon or thereabouts. We would expect some cementite to be present with the combined carbon, ranging from 1.25 to 1.65 per cent.—EDITOR.]